THE ILLUMINATING ENGINEER
THE JOURNAL OF
GOOD LIGHTING
LIGHT LAMPS FITTINGS AND ILLUMINATION
OIL · GAS ELECTRICITY ACETYLENE PETROL-AIR GAS ETC.
Official Organ of the Illuminating Engineering Society
FOUNDED IN LONDON 1908
Edited by LEON GASTER

Vol. XIX | February, 1926 | Price NINEPENCE
Subscription 10/6 per annum, post free.
For Foreign Countries, 15/- per annum.

EDITORIAL AND PUBLISHING OFFICES:
32 VICTORIA STREET, LONDON, S.W. 1.
Tel. No.: Victoria 5215

Problems in the Lighting of Coal Mines

THE discussion before the Illuminating Engineering Society on this subject on Jan. 21st led to the presentation of some useful information. It is the practice of the Society to review at periodic intervals various subjects which are in a state of development. The joint discussion with the Royal Society of Medicine in 1920 revealed a general recognition of the importance of good lighting in mines. The conclusion then arrived at, that the disease known as miners' nystagmus is mainly due to inadequate illumination, has since been amply confirmed. Mr. J. B. Lawford (past president of the Council of British Ophthalmologists) in opening the discussion endorsed this conclusion, and the experience of Dr. Stassen, of Liège, presented at the International Congress of Industrial Hygiene at Geneva in 1924, was to the same effect. There can also be little doubt that inadequate lighting has other drawbacks, for example in being responsible for certain accidents in mines.

During the years that have since elapsed there have been some advances in the design of miners' lamps, and further experience has been gained in regard to ideal requirements and possible solutions. The moment therefore appeared opportune for a discussion on lighting conditions—doubtless one of the most important problems from the standpoint of health, safety and efficiency of work in collieries.

The opening paper by Mr. Eric Farmer dealt with some of the researches carried out by investigators of the Industrial Fatigue Research Board on methods of diminishing the tendency to glare from the unscreened filament of the miner's electric lamp. In the very dark surroundings in which miners work it is natural that even a source of comparatively low candle-power and brilliancy should be liable to dazzle the eyes. One was therefore prepared for the conclusion arrived at in Mr. Farmer's paper, that methods of diffusing the light (preferably by frosting the interior of the glass cylinder) are generally conducive to better vision, and likewise more comfortable to miners suffering from incipient nystagmus. This was found to be the case notwithstanding the fact that the diffusing medium inevitably involves some loss of light. At the same time the importance of increasing the candle-power available from miners' lamps was strongly emphasized. Following the discussion examples of electric lamps using a larger battery and capable of furnishing 4 c.p. or more were exhibited. On the whole, experience suggests that miners may be willing to accept the greater weight of such lamps in consideration of the great advantage of increased illumination. But there is also the possibility that ultimately improvements in batteries and the use of more efficient lamp-bulbs may enable a substantially higher candle-power to be obtained without the overall weight of the lamp being very much altered. Other possibilities are the use of the cap-lamp or reflectors and lenses which confine the light to a beam, but give a much higher illumination over the area illuminated, and at the same time screen the filament from the eyes of the miner. The above remarks refer to the design of electric lamps, which was traced somewhat fully in Mr. Plummer's contribution to the discussion, but the possibility of improvements in the light given by flame lamps should also not be overlooked, and in this connection the new lamp exhibited by Mr. Hailwood, stated to furnish 3 c.p., was interesting.

However well designed a lamp may be initially it is obvious that great importance must be attached to the way in which it is used and maintained. The miner can to a great extent avoid possible glare by the judicious placing of his lamp so that the filament does not come between his eye and the surface worked upon. The conditions under which bulbs and batteries are tended are also extremely important, and the remarks made by Mr. Plummer in regard to the training of lamp men and instruction in methods of tending and charging batteries deserve attention. Of equal importance is the selection of bulbs for use in lamps. This point was dealt with by Mr. Sack, who gave a useful demonstration of the loss in light from lamps operated at a low efficiency. There is a temptation to some collieries to purchase lamps of inferior manufacture, but apparently cheap. There is also a tendency to demand a life of 1,000 hours, which cannot be expected from a miniature 2-volt lamp operated at a reasonable efficiency. In such circumstances it is difficult to maintain even the 1 c.p. standard, and to sacrifice light unduly with a view to keeping down costs of bulbs is doubtless false economy. It was interesting to hear at the meeting that there is a prospect of a standard specification for bulbs used in miners' lamps being considered shortly. Such a specification would no doubt bring about a material improvement.

Yet another problem is the *colour* of the light.

The whole problem of the provision of adequate illumination in mines is obviously one of national importance. Dr. Llewellyn, in his paper read before the Society in 1920, stated that 6,000 men had been disabled every year since 1913 from miners' nystagmus, and that the cost to the country was not less than £1,000,000 per annum. Evidently, therefore, this is a case where expenditure on the best available illumination should be amply justified.

The City Smoke Problem and the Press

A TIMELY paper on the above subject was read by Dr. J. S. Owens, the Chairman of the Circle of Scientific, Technical and Trade Journalists, at the meeting of the Circle held on February 16th. After briefly reviewing the history and growth of the smoke problem in cities, Dr. Owens emphasized the importance of the press in bringing about public realization of the need for improvement. He mentioned that smoke cost, in London, about 24s. per head of the population per annum (equivalent to over £7,000,000 per year), when all its deleterious effects were taken into account; in Manchester the corresponding cost was about 30s. per head; and in other cities, such as Pittsburgh, even higher.

The sources of economic loss in connection with the smoke problem are manifest. Its accentuation of fogs means that artificial light is often necessary when, with a clear atmosphere, daylight would still suffice. The accumulation of soot on windows, woodwork and stonework means increased expenditure on cleaning. Not the least important of the economic losses occasioned by smoke-laden atmospheres is the disturbance of traffic through the formation of dense fogs—a condition that can at present be only imperfectly relieved by the use of artificial illuminants of small penetrating power. But of even greater consequence than the economic aspect is the hygienic drawback of the vitiated air and the obstruction of sunlight by the smoke of modern cities.

Dr. Leonard Hill, who opened the discussion, drew special attention to this last aspect. The loss of visible light through smoky atmosphere is easily appreciated. But it is less generally known that the ultra-violet rays in sunlight are particularly absorbed and weakened. Dr. Hill illustrated this by a series of charts showing the comparative ultra-violet intensity during the same month in Switzerland, in country air near Oxford, and in Kingsway, London. The diminution caused by the smoky atmosphere in the latter case was very marked. It will be recalled that Dr. Saleeby, in his address to the Illuminating Engineering Society last year, explained the view held by modern hygienists in regard to the beneficial effect of sunlight on health—an influence which is ascribed very largely to the ultra-violet rays. The accumulation of smoke in the atmosphere, by obstructing sunlight, is believed to contribute very largely to the general tendency to ill-health during the winter, when the sun's rays are least powerful. It is curious to reflect that in former times the emission of smoke into the atmosphere was regarded as an offence at law, and it is only in comparatively modern times that it has come to be more or less tolerated. The existing regulations appear to differ widely in different localities, and it is understood that the Bill dealing with Smoke Abatement now before Parliament will lead to better conditions in this respect. Meantime it is necessary to study preventive measures. The problem is of direct interest to both gas and electrical undertakings, in view of the possibilities that the more general use of gas and electricity will have the effect of diminishing smoke. In particular, the hope has been expressed that the Government's proposals in regard to electrical bulk supply will lead to improvement. We trust that the possibilities of smoke abatement will form an integral part of these proposals for more efficient generation of electricity, and that the new super-stations will be run in such a manner as not only to afford cheap electricity, but to utilize fuel in the most efficient manner.

A New Tungsten Arc Lamp

IT is now about ten years since Mr. S. R. Mullard described before the Illuminating Engineering Society the "arc-incandescent" lamp between two tungsten electrodes, now known as the "Pointolite" lamp.* A new "self-starting" lamp, also based on the formation of an arc between two globules of tungsten within a hermetically sealed glass envelope, is now described by Dr. Halbertsma, of the Philips Lamp Works, in this issue. The lamp has interesting characteristics, and it is believed that it will prove useful for optical work, where a source of high and uniform brightness and small dimensions is required. One special device is the arrangement whereby one electrode may partially eclipse the other, thus giving a source of very small area in cases where a close approach to a "point source" is required. It will be noted that the characteristic curves relating to voltage and current are quite different from those of the ordinary incandescent lamp. As a result, the change in candle-power corresponding to a given alteration in voltage is comparatively small—a circumstance that suggests that the lamp might sometimes prove useful in the photometric laboratory. Another curious circumstance is that both over-running and under-running the lamp cause increased blackening of the bulb, and there is no advantage to be gained by under-running. We shall watch the development of this lamp with considerable interest.

Illumination and Light

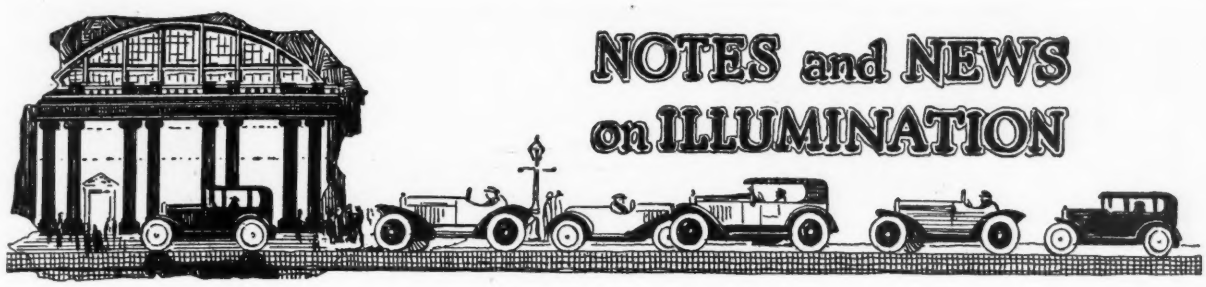
DURING recent years the Institution of Electrical Engineers has on several occasions afforded opportunities of discussing various aspects of illumination, especially in connection with the informal "talks." Another notable instance is afforded by the Faraday lecture given by Mr. A. P. Trotter at Manchester, and also at Liverpool, Dublin and Cardiff.

Mr. Trotter took for his subject "Illumination and Light." As a past President of the Illuminating Engineering Society, and as one who for some 45 years has been interested in illumination, he has encouraged the development of illuminating engineering from its earliest inceptions; much early pioneering work in illuminating engineering is associated with his name, and he has been identified alike with the study of the practical and theoretical aspects of light.

We hope shortly to be able to give a fuller account of this instructive lecture, and for the moment we will only give a brief indication of the ground covered. Mr. Trotter referred to the development of interest in lighting problems since the formation of the Illuminating Engineering Society, and illustrated his remarks by comments on many of the problems with which the Society has been concerned—the avoidance of "glare," the amount of illumination necessary for various purposes, and the work of the Home Office Departmental Committee on Industrial Lighting.

The latter part of the address was concerned mainly with the theory of light. It was not until 1846 that the relation of light to another branch of physics (magnetism) was realized by Faraday, and his conceptions have dominated subsequent speculations on the nature of light. Yet at the present time we are conscious that there is much connected with the behaviour of light that we do not understand, and that our present theories may need modification. As Mr. Trotter remarked, "A new Faraday is wanted."

* *Illum. Eng.*, January, 1916, p. 14.



The Optical Convention, 1926

Particulars of membership of the Optical Convention, to take place during April 12th to 17th at the Imperial College of Science and Technology (South Kensington), are now available. The programme includes an address by the President, Sir Frank Dyson, the Astronomer-Royal, and papers dealing with various aspects of optics, photometry, etc., are now being arranged. There will also be special illustrated lectures of a popular character and entertainments, including dramatic performances, incorporating various interesting optical illusions. We observe that the committee concerned with the latter will have the co-operation of Sir Richard Paget, Dr. R. S. Clay, Capt. Clive Maskelyne, of St. George's Hall, and Mr. Kenneth Barnes and M. Komisarjevsky, and the students of the Royal Academy of Dramatic Art. These performances ought, therefore, to be both instructive and entertaining. The exhibition will be arranged in three sections: (a) Experimental and Research, (b) Historical, and (c) Commercial, and a fully illustrated catalogue will be available. The Chairman of the Executive Committee is Mr. F. Twyman, F.R.S., whose name is familiar for much interesting research work in optics and photometry, and the secretary (from whom all particulars may be obtained) is Mr. Thomas Martin (1, Lowther Gardens, Exhibition Road, South Kensington).

Working Illumination in Relation to Material Used

In considering the illumination necessary for various industrial processes the important part played by the nature of the material illuminated should not be overlooked. The dominant factor in such cases is the *brightness* of the material as seen by the eye, and experiments have shown that the product of the minimum illumination for comfortable working and the coefficient of reflection of the material is almost constant; in other words, the amount of illumination necessary is almost directly proportional to the percentage of light absorbed by the material. One of the best illustrations of this effect is to be found in the clothing industry. Workers on black or dark-blue cloth require a much higher illumination than would suffice for light material; indeed with very dark stuffs it is difficult to obtain economically the desired illumination by general methods, and for very fine work a well-shaded local light may be necessary. The relation between the necessary illumination and the reflecting power of the surface illuminated was strongly emphasized in the lecture entitled "Ideal Requirements and Practical Solutions of the Lighting of Clothing Works," given by Mr. L. Gaster before the Jewish Institute on January 23rd. The lecture was illustrated by an effective demonstration with samples of cloth in a variety of shades, arranged with the co-operation of the E.L.M.A. Lighting Service Bureau.

Flexible Glass

Much interest has been aroused by the announcement that a form of flexible glass, which is also much lighter than the ordinary variety, has been discovered. It is stated that the glass made by this special process will not splinter, and when thrown on the ground does not break, but bounces, showing remarkable resilient properties. This new development will be watched with great interest. It remains to be seen whether the glass can be manufactured in bulk inexpensively, though hopeful views on this point are expressed. An obvious application would be for the wind-screens of automobiles, and no doubt more will be heard of the glass at the Motor Exhibition this year. There are, however, many other possible applications for a glass such as that described. Its flexible and robust nature might render it useful for lighting appliances, especially if, as is reported, it is very much lighter than ordinary glass. In the lighting of very large halls with diffusing glass bowls the manufacture of units of sufficient dimensions has always been something of a difficulty. The new glass might enable one to encourage the construction of much larger fittings than are used at present—for instance, the development of very extensive hoods and bowls, carrying masses of lamps of high candle-power and mounted at a great height.

Why Shading Lights is Profitable

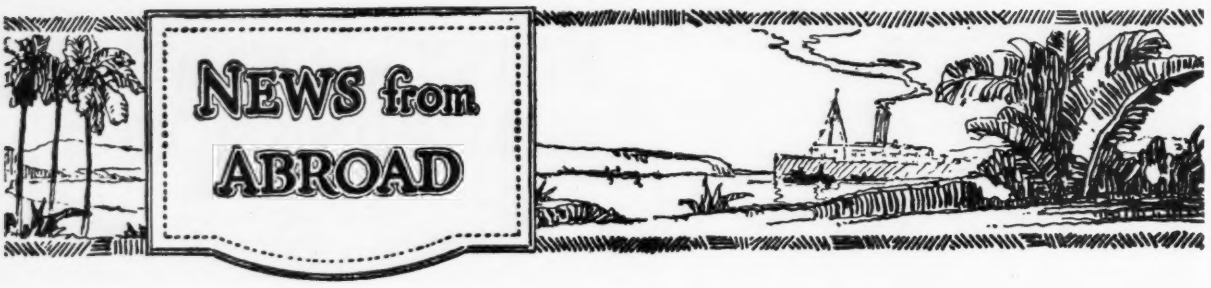
To the lighting expert the idea that a suitable globe, bowl or reflector is a necessary adjunct to a lamp, in order to distribute the light where it is mainly wanted, is so familiar that he wonders sometimes why non-technical people do not at once grasp this necessity. The usual explanation doubtless lies in a confusion between the value of the illumination and the brightness of the source. Some people still seem to find a difficulty in understanding why a room filled with glaring lights may nevertheless be "underlighted" in the sense that the illumination is inadequate. Electrical and gas supply undertakings, makers of lighting fittings and others interested in illumination should bear in mind that the presence of glare from imperfectly shaded filaments and mantles is largely responsible for public indifference to the need for better illumination. This point is explained in a recent issue of *The Electrical World*. An interior in which light sources are unshaded is apt to appear overlighted, and many of the objections that are commonly raised to higher illuminations are really based on the impression that this involves increased glare.

Illuminations at Leeds

A feature of the forthcoming tercentenary celebrations in Leeds, next July, will be the decoration of the streets and buildings. A meeting of traders was convened recently by the Leeds Chamber of Trades to discuss methods. Proposals include: An invitation to citizens to put out flags and bunting, decoration of the Town Hall, electric illumination of public and principal buildings by night, electrical illumination of the City Square with set and changing pieces, festoons of electric lamps between tramway standards on principal routes, and additional illuminations on Friday, July 16th ("Charity Day") outside the General Infirmary. Another feature will be special shop-window displays. The fact that the celebrations will take place in midsummer is somewhat inconvenient for lighting displays, but no doubt modern resources will enable an effective display to be arranged.

A Survey of the National Coal Resources

We are informed that, in connection with the fuel research undertaken by the Department of Scientific and Industrial Research, a further committee has now been formed to survey the coalfields of Nottinghamshire and Derbyshire. Committees have already been formed to deal with the Lancashire and Cheshire, South Yorkshire, North Staffordshire and Scottish areas.



Illuminating Engineering in Germany

During the past month we were favoured by a call by Dr. Körting, of Messrs. Körting & Mathiesen (Leipsic), who have for many years been associated with the manufacture of lighting fittings in Germany, and have taken a great interest in the illuminating engineering movement in that country. Dr. Körting informed us that interest in the subject of lighting in Germany is growing rapidly, though there, as elsewhere, considerations of economy have somewhat limited practical progress. Propaganda in favour of better lighting are being energetically taken up both by the German Illuminating Engineering Society, and by manufacturers of lamps and lighting appliances, and electric supply undertakings have shown a ready response to suggestions for educational propaganda, and have co-operated in arranging courses of lectures, etc. It appears that at present the State in Germany does not in general impose direct regulations bearing on industrial lighting, etc. But it has been found that officials now take a much keener interest in illumination and readily invite co-operation when lighting problems arise requiring investigation. Dr. Körting expressed great interest in the methods pursued in this country, and especially in the work of the Illuminating Engineering Society and the Committee working under the Department for Scientific and Industrial Research. He fully concurred in the view, which is shared by experts abroad, that research and investigations by bodies of an impartial and scientific character are most necessary in order to carry conviction with the public and form a valuable basis for propaganda undertaken by those directly connected with the lighting industry.

Other Developments Abroad

Another welcome visitor during the past month has been Dr. Halbertsma, who is connected with the Philips Lamp Works at Eindhoven, Holland. We understand that developments in Holland are proceeding rapidly, the leading cities being in the main excellently lighted, whilst many exceptionally good examples of shop-window and flood-lighting exist. Much interest is being taken in illumination, and it is hoped that in the near future a Dutch National Committee on Illumination will be formed. Another item of news relates to the important Hygiene Congress to be held in Dusseldorf. We understand that illumination will be a special feature at this exhibition, and that a considerable area has been placed under the charge of Professor Dr. Teichmüller for the purpose of arranging a thoroughly representative exhibit of correct methods of lighting. This is one more example of the recognition on the part of hygienists that good illumination is a vital necessity to health. It will be recalled that at the recent international hygienic congresses in Paris and Geneva much interest was shown in this subject.

The Association for the Advancement of Science in France

We note that the Association pour l'Avancement des Sciences will this year celebrate its fiftieth birthday at the 1926 Congress to be held in Lyons. Between July 24th and August 1st there will also be an extensive exhibition in the Palace of the Fair at Lyons, special attention being devoted to exhibits of a scientific character. The exhibition is international in scope, and should be of interest to many concerned with science in this country. Further particulars may be obtained from Monsieur H. Pilon, Commissaire General de l'Exposition pour l'Avancement des Sciences, 23, Rue Casimir Perier, Paris.

A Photometric Standard for Sensitising Photographic Plates

In the *Bulletin* of the Société Française des Electriciens M. Ch. Fabry presents a review of recent progress in connection with the sensitising of photographic plates—a matter of joint interest to photographic and photometric experts. The problem was discussed at the International Congress on Photography held in Paris last July. It is agreed that sensitising processes should be related to the international candle, but obviously some allowance for actinic value must be made. At the 1925 Congress two suggestions were made. The Royal Photographic Society of London proposed to adopt as the "photographic candle" one candle-power yielded by a source of colour equivalent to a temperature of 2360° K. (readily attainable from the vacuum tungsten lamp). The second proposal, emanating from the United States, was to adopt a lamp of similar temperature but equipped with a blue glass designed to correct the light to an approximation to normal daylight. The first proposal was adopted, with the supplementary note that by the use of a suitable filter and approximation to daylight value may be obtained. It is, however, still necessary to be able to compare sources having different actinic power, and M. Fabry suggests that this should be done by means of curves showing the distribution of energy in the spectrum, all presented on the basis of equal aggregate energy. The details, however, still require considerable working out. Hitherto it has been sometimes difficult to compare data of this description, owing to variation in the manner in which it has been presented.

The National Association for the Prevention of Industrial Accidents

L'Associazione degli Industriali d'Italia per prevenire gli infortuni del lavoro, the official body in Italy concerned with industrial accidents, has recently adopted a new title;—"*L'Associazione Nazionale per la prevenzione degli infortuni sul lavoro*" (National Association for the Prevention of Industrial Accidents). The Association's activities will fall under two sections, dealing respectively with accidents in factories and in agriculture. The work of the Association deserves to be well known in this country. Amongst its objects are the appointment of specialist inspectors, the study of all conditions relating to safety in industry and agriculture, the encouragement of protective measures, the organization of instruction and propaganda, etc. and the function of reporting to the Government all measures necessary in the interests of safety. The Association is under the direction of Ing. F. Masarelli, a valued corresponding member of the Illuminating Engineering Society, who has taken a great interest in the question of illumination in relation to safety of workers.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

The Lighting of Coal Mines

(Proceedings at the meeting of the Illuminating Engineering Society, held at the House of the Royal Society of Arts, 18, John Street, Adelphi, London, W.C., at 7 p.m.. on Thursday, January 21st, 1926.)

A MEETING of the Illuminating Engineering Society took place at the House of the Royal Society of Arts (18, John Street, Adelphi, London, W.C.), at 7 p.m. on Thursday, January 21st, 1926, Mr. C. C. PATERSON presiding.

The minutes of the last meeting having been taken as read, the HON. SECRETARY read out the names of the following applicants for membership:—

Brewer, P. G.....British Thomson-Houston Co. Ltd., Crown House, Aldwych, London, W.C.

Halsted Hambley, Capt. E. J., Managing Director of Halstead Hambly & Co. Ltd., 65, Wool Exchange, Coleman Street, London, E.C.2.

Spencer, R. J.,.....Designer, 115, Dalmeny Avenue, Norbury, S.W.16.

The CHAIRMAN then called upon Mr. ERIC FARMER, of the Industrial Fatigue Research Board, to read his paper, which was as follows:—

A Consideration of Some of the Psychological Aspects of Illumination in Coal Mines

By ERIC FARMER

(Investigator to the Industrial Fatigue Research Board.)

During an investigation carried out by the National Institute of Industrial Psychology in a coal mine a special laboratory experiment was made in connection with certain aspects of pit illumination. The investigators who were carrying out the inquiry were underground during the whole of the working shift, and they noticed that their eyes were constantly irritated by the small localized points of light emitted by the miners' lamps. They believed this irritation to be due to the persistent nature of the after-sensations caused by the stimulation of the unshaded lights to which they were exposed. It did not, however, follow that because strangers who had not become accustomed to pit conditions suffered in this way miners would suffer in the same degree, and it was in order to test this point that the experiment was instituted.

Before we go on to consider the actual experiment we must digress for a few moments in order to make clear what is meant by after-sensations. When the sensory end organs, such as the eyes and ears, are stimulated in the appropriate way sensations are experienced, and these sensations tend to persist after the original stimulus has ceased to operate. This persistence of the sensation tends to make a more lasting impression than would be the case if the sensations ceased with the cessation of the stimulus, so that after-sensations perform a useful biological function. If, however, they are so persistent that they interfere with the clear presentation of the next sensation, then they cause confusion and subsequent irritation. The factors which tend to cause persistent visual after-sensations are clearness and definite localization of the original stimulus and marked contrast in the total presentation. The best way of demonstrating this is to look fixedly at a window divided by a window frame. If we then close our eyes we shall continue to experience the original presentation, for we shall see a bright field with a dark bar across it. In the presentation of the window we have clearness of outline and a definite contrast between the light transmitted through the window and the intersection of the light by the middle window frame. Those of you who are familiar with the ordinary miner's lamp will see at once that it produces similar conditions. The transparent bulb makes the filament, and not the surface of the bulb, the source of light, so that it is very definitely localized, and the contrast effect is provided by the black surroundings of the pit, and the intersection of the light by the supporting pillars of the outside glass funnel.

Clearness of presentation is obviously a function of two factors. Firstly, the angle at which the beams of light fall upon the retina, and, secondly, the sharpness of definition of the original source of light. The operation of these two factors was tested separately.

THE EFFECT OF THE POSITION OF THE LAMP.

The method of carrying out the experiment to determine the connection between the position of the lamp and after-sensations was to seat the subject in a dark room and stimulate his eyes by switching on an ordinary pit lamp of one foot-candle-power placed in seven different positions in a circle of 21 inches radius. The positions were immediately in front of the subject's eyes, so that the beam of light fell directly on the fovea and at 30°, 60°, and 90° to his right or left. The results from all the subjects were quite consistent, and showed that after-sensations were more numerous and more persistent when the rays of light fell directly on the fovea and that they became less numerous and less persistent as the angle at which the lamp was placed in relation to the eyes became more acute. The practical conclusion to be drawn from this experiment is that the miner should place his lamp, as far as possible, in such a position as not to directly stimulate his eyes, and that when this is impossible the angle at which the rays of light strike the eye should be as acute as possible.

NATURE OF THE SOURCE OF LIGHT.

Experiments were also carried out to see how altering the source of light by painting the bulb or the outside cylinder with various preparations affected the number and persistence of after-sensations. I need not trouble you with all the devices experimented with; full details of these experiments will be found in *The British Journal of Psychology*, vol. xiv, part 2, October, 1923, pages 153-163. Here it is sufficient to say that any device that rendered the source more diffuse considerably

reduced the effect of the after-sensations. The best results were finally obtained by painting the inside of the protecting cylinder with hydrofluoric acid, which made it translucent instead of transparent, thus diffusing the light. By painting the inside, the outside of the cylinder remained smooth, so that coal dust could easily be removed.

INTENSITY AND ACUITY.

Treating the lamps in this way naturally reduced their physical intensity, and since the ordinary mining lamp is only of one foot-candle-power (often in practice they are much less), anything that reduces the intensity still more would be a retrograde step unless acuity remained unaffected. A group of mining subjects were tested for visual acuity with the transparent and translucent lights and their records compared. It was found that 53 per cent. of the subjects had better visual acuity with the translucent light than with the transparent; 32 per cent. of the subjects had equal acuity with either lamp; and 14 per cent. of the subjects had lower visual acuity with the translucent light. It will be seen, therefore, that in spite of reducing the intensity of the source the actual power of seeing was either better or unaffected in 85 per cent. of the subjects, so that there is no reason for rejecting the use of translucent lights merely on account of the lowered intensity they entail. The fact that on the whole they do not unfavourably affect visual acuity is curious, and one is inclined to hazard the suggestion that it may be due to their less fatiguing effect upon the eyes which enables the latter to perform their functions better in spite of a lower illumination.

Experiments were carried out to determine the best positions of the filament, and it was found that if it was placed lengthwise in relation to the coal face a better illumination was obtained than if it were endwise. No attention seems to have been paid to this point by the manufacturers, but it is an extremely simple matter to arrange, and one entailing no extra expense or trouble.

The translucent lights were greatly appreciated by the miners, and they were quite spontaneous in the expression of their opinions. They felt their eyes less strained, and they also noticed that the shadows cast by the supporting pillars of the lamp were less marked with the translucent light than with the transparent, and this naturally met with their approval.

Certain nystagmus subjects were tested in the ways already described, and it was found that they experienced far more numerous and persistent after-sensations than the normal subject. Since the symptoms of nystagmus are a rolling of the eyes similar to the movement of the eyes when they are trying to overcome the effect of a persistent after-sensation, it is not improbable that the clear after-sensations entailed by the use of a transparent source of light are one of the contributory causes of this trying occupational disease.

It may seem to some that the foregoing experiments are an elaborate way of proving an obvious truth, and that even when their results are adopted very little has been done to improve the illumination conditions of mines. With regard to the first criticism, we must remember that all scientific truths seem obvious when once they have been discovered, and also that a fact that has been proved by careful experimentation must carry more weight than an opinion held without the support of scientific knowledge. That the improvements which are possible as a result of these experiments are small is no fault of the experimenters. In the particular mine where these experiments were carried out it was impossible to use a heavier lamp than the one ordinarily in use, giving at its maximum one foot-candle-power, With such a low illumination the margin of improvement must necessarily be small, but anything that can improve conditions which are naturally so unfavourable must be regarded as most desirable.

In some parts of the mine it was possible to use a much larger lamp, giving greater illumination, so that the working conditions were greatly improved. I have been told by a mining doctor, who has attended a group of pits for many years that he has noticed that a fewer number of accidents and fewer cases of nystagmus come from those pits where it is possible to use more powerful lamps. I believe that one of the greatest improvements that can be effected in the mining industry will be in the direction of improved illumination. Efforts should be made to produce a lighter lamp, in order that larger lamps giving greater illumination can be manufactured and still be of a reasonable weight, so that the miners can easily carry them to the coal face. A good deal might be done by carrying really powerful lamps to the coal face in the empty coal trucks; in fact, no effort should be spared in making the illumination conditions better. Any expense this may involve will be amply repaid for by increased output, fewer accidents, and fewer cases of compensatable nystagmus.

Finally, I should like to add that the scientific value of these experiments is not so much in the results that were obtained, but in the technique that was employed. As far as I know, this is the first time that the effect of various methods of illumination has been compared by examining the nature of the after-sensations caused by them, and great credit is due to Messrs. Stephenson and Adams—the investigators responsible—for their work in instituting a new method of approach. I believe there are great possibilities for further research along similar lines, and I should like to see other methods of illumination tested in the same way. The goodness or badness of any method of lighting is ultimately the effect it has upon the organism, and this is most difficult to measure because we can never be sure that any ocular defects that finally appear are mainly due to the lighting conditions to which the subject has been exposed. If, however, we can measure the effect of various methods of illumination in ways similar to those already described we may be able to throw some light upon one of the most vexed questions in industrial hygiene

Communications

The CHAIRMAN then called upon the HON. ASSISTANT SECRETARY (Mr. J. S. DOW) to present various communications that had been received.

Mr. DOW mentioned that a letter had been received from the Rt. Hon. WILLIAM BRACE, M.P. (Chief Labour Adviser, Mines Department). It would be recalled that Mr. Brace, when present at the last annual dinner of the Society, had strongly expressed his appreciation of the need for good illumination in mines. In his present letter he expressed regret at being unable to attend the meeting, and added: "Need I say that I am in the fullest sympathy with all efforts for improving the lighting system of the coal mines of our country, and I wish your effort in this respect all success."

Mr. HENRY WALKER (H.M. Chief Inspector of Mines) and Mr. E. FUDGE (Secretary of the Miners' Lamps Committee) had also written expressing their regret at inability to attend. The latter added: "The work described by Mr. Farmer on visual acuity is very interesting. I should particularly like to know whether any comparative tests have been made of visual acuity as between electric safety lamps and flame safety lamps of the same candle-power. I shall be very much obliged if you will send me a report of the meeting as soon as published."

Mr. FRANK HODGES (the Secretary of the International Miners' Federation) had also written stating that he hoped to be present, but had been unable to do so.

The HON. ASSISTANT SECRETARY next read a contribution to the discussion received from Dr. T. Lister Llewellyn, who had read a paper before the Society in 1920, when this subject was last dealt with.

Contribution from T. Lister Llewellyn, M.D.

The illumination of coal mines has improved since I read my paper on "Lighting Conditions in Mines" before your Society in 1920. This improvement has been brought about by the general realization of the importance of lighting, which is probably due to the good work of your Society, and by the helpful reports of the Miners' Lamp Committee. The greater use of electric lamps, the improvements of both oil and electric lamps and the whitewashing and stonedusting of underground roadways have all played their part. The intro-

duction of translucent glasses by Mr. Farmer and his co-workers, the use of tinted glasses and the more intelligent application of reflectors have also been steps towards the solution of a most difficult problem.

In 1920 I advocated the use of the cap lamp, but so far this type of lamp has been a failure, except in some districts of Scotland where miners have been accustomed to carry their light on their heads. I still believe the cap lamp to be the solution of the problem of underground lighting. Its universal use in America, where the latest types give four candle-power, confirms me in my opinion. The chief objections to its more general introduction are the difficulties of accommodation in and distribution from the lamp room.

In the coal mine all the canons of good illumination are broken—the source of light is deficient in candle-power, and from the low height of the working places often so placed that direct rays shine into the workers' eyes. There is lack of contrast, and the low reflecting power of the containing surfaces prevents a uniform distribution of light.

Glare is usually associated with a light source of some intensity, but in the poor illumination of the coal mine direct rays of light, even if feeble, produce discomfort. Glare should be prevented by (a) use of the cap lamp, (b) careful placing of the lamp, (c) use of reflectors, (d) the use of tinted or translucent well glasses. In my experience the translucent glass has not been well received by the men, and they object to all forms of lens well glass. The lens increases the light in the horizontal level, but produces an irregular field of illumination with patches of shadow. The tinted glasses have been very well received, and although there is a slight loss of candle-power it may be that the yellow light enables a greater contrast to be made between the blue-grey shale and the coal. The use of shades at the back of the lamp during the journey to the coal face should be made compulsory. It is very annoying to follow an unshaded lamp, and one of the earliest symptoms of eye trouble is the difficulty of following an unshaded lamp.

During the period 1912-1924 the number of electric lamps has increased from a few thousands to 356,000 and the number of oil lamps has fallen from 750,000 to 576,000.

What has been the result of the improvement in underground lighting in output, safety and industrial disease? From 1919-1922 there was a steady fall in the accident rate, and the number of cases of industrial disease reached a steady level. From 1922 there has been a great increase in the number of accidents and cases of industrial disease. The output, in spite of the seven-hour day, has increased.

	1920.	1923.	1924.
Men employed underground...	990,359	979,785	979,108
Output in million tons.....	229	276	267
Cases of disablement	134,738	245,479	not available.
Cases of nystagmus reported in the year	2,865	3,872	3,411

These figures are very unsatisfactory and are a measure of the industrial depression and unrest of the present time. The Miners' Nystagmus Committee hold that there has not been an increase in the total number of cases of nystagmus, but only in the reported cases. The incidence of the disease has been found to vary with the rate of wages and state of the trade. There can be no such explanation for the great increase in the number of accidents reported in 1923. Output alone shows an increase, and even here 1924 has not maintained the figures of the previous year. It is to be hoped that with a return to more normal conditions there will be a fall in the accident and disease rate, and that the output will be more than maintained. In spite of the pessimistic tone of this communication, I remain as convinced as ever of the importance of an adequate illumination for underground workers.

Contributions from Dr. H. S. ELWORTHY (who also participated in the discussion of 1920) and Dr. W. M. THORNTON (of Armstrong College, Newcastle-on-Tyne) were next presented.

The Effect of Yellow Glasses

At the previous discussion before the Society Dr. Elworthy reported favourable experience of the effect of yellow-tinted glass in minimizing nystagmus, and at his request confirmatory figures are now kindly furnished by the Ebbw Vale Steel, Iron and Coal Co. Ltd. The figures for nystagmus were as follows:—

Group.	1924.	1925.
"A"	7	7
"B"	5	6
"C"	5	5
"D"	14	10
"E"	16	5
	47	33

From these figures it is evident that the number of cases was much less than in the previous year. This is attributed largely to the using of yellow glasses at all these collieries.

It is also stated that of the 33 nystagmus cases which came on the books of the Company during 1925, only 27 were still on in December, 1925, six cases having resumed their own or surface work.

Wiring Mines for Electric Light

Dr. THORNTON, in his letter, mentioned that he had taken electric lamps into many places where only oil lamps were formerly used. He found that workers welcomed improved illumination, and if they felt the same confidence in the electric lamp as a detector of gas that they had in the oil lamp a great deal of reluctance to installing electric lamps would be overcome. It seemed possible that nystagmus is not only physiological but mental. It appeared that poor lighting caused what is called an "apprehension neurose" with a certain class of men or men in certain localities; in such cases there is subconscious effort on the part of the hewers to watch at the same time the immediate effect of the cut and the general state of the place in which they are working. This double attention might be one cause of nystagmus; but there was no doubt that it was accelerated by bad lighting, for in a well-lighted place much of the uncertainty is removed.

Dr. Thornton mentioned that flood-lighting at the face had already been tried in certain Scottish mines, he believed with good results. Experiments were made some years ago on the possibility of using low-voltage alternating currents at higher frequencies than are now common. This led him to believe that it might be possible to convey electricity to working places by suitable cables carrying such currents, and thus to give the working miner, hewer or filler all the light he could desire. The question of the safety of such a system was still under discussion, and it would need to be very fully tested before coming into use; but so much was now known as to the part played by inductance in the circuit, and by the time of duration of the spark in the ignition of firedamp, that it did not seem beyond the skill of man to devise complete safeguards. Such precautions had already been taken in the case of signalling underground, and the voltages proposed to be used for lighting did not exceed those now permitted for signalling.

In conclusion, Dr. Thornton remarked that the effect of good lighting on the strain of a collier's life could not but be beneficial, and had also had the effect of increasing outputs in districts where it had been tried. A 14 per cent. increase was in one case mentioned. If this was confirmed it would suggest that this was at least one avenue by which output might be increased, the importance of which at the present time could not be disregarded.

Discussion at the Meeting

Professor J. B. LAWFORD (Council of British Ophthalmologists) emphasized the extreme importance to those in the mining world, and indirectly to others, of improving the illumination in mines in every possible way. The question of the relation of bad illumination to nystagmus had been widely discussed, and there was still some difference of opinion. But he believed that the

majority of men in his profession thought that the disease was largely due to want of illumination; the cramped and distorted position in which the miner had to work was also suggested as a contributory cause, but he thought that it played a much less important part than defective illumination. He and his colleagues were heart and soul with those who tried to improve illumination in pits. Where it had been possible to introduce better illumination the number of cases of the disease had been much reduced; but it was exceedingly difficult to raise the standard of illumination sufficiently to ensure good work without any deleterious effects.

Dr. D. G. COLES inquired what colour of light was generally regarded as most efficacious. He had recently been concerned with the problem of providing coloured glass for people exposed to excessive light, and the diversity of tint found in different countries was remarkable. The Germans suggested smoke colour, the Americans grey, and other authorities red. In this country both amber and yellow had been recommended; whilst a combination constituting a black glass had been recommended for work with electric arcs, and in acetylene welding he had found a number of places where the prevalent tint was blue. In regard to illumination, he attached importance to placing lamps in such a way that no direct rays of light entered the eyes. One source of trouble was mist on the glass, and this had to be avoided by efficient ventilation.

Mr. T. J. SACK said he was very glad to learn from Mr. Farmer's paper that the illumination, or rather, lack of illumination in coal mines, was still receiving the attention it deserves from the National Institute of Industrial Psychology. He remembered reading an account of some investigations made by this Institute on the improvements effected on output by increased illumination. The same subject was now treated from a different point of view, namely, the effect of illumination on the eyesight of the miner. When one considered the miserable illumination under which the miner had to work, it was small wonder that his eyesight was adversely affected. Assuming that a miner's lamp gave one candle-power, then at a distance of six feet, the illumination on the coal face would be 1/36th foot-candle. Now, the black surface of the coal absorbs at least 90 per cent. of this light, so that actually the light that enters the miner's eye is 1/360th foot-candle. As compared with this, he might mention that the illumination considered necessary in an office where work was being done on white paper was in the neighbourhood of 10 foot-candles; and that in workrooms where black material was being worked upon as much as 50 foot-candles was found necessary.

When miners' electric hand lamps were first introduced into the mines there was a marked diminution in the incidence of miners' nystagmus, due to the superior illumination of the electric lamp as compared with the old flame lamp. Unfortunately, this improvement had not been maintained, and in his opinion it is due to the fact that low-efficiency long-life bulbs have been introduced into miners' electric hand lamps, which in many cases do not give more than 0·5 of a candle-power. It was a discreditable state of affairs that the miner should be deprived of even his miserable one candle-power in order to save a few pence per annum per hand lamp! This was obviously false economy, as it was indisputable that reducing the miner's light must have an adverse effect on his output, to say nothing of the effect on his eyes.

It was unreasonable to expect a small 2-volt 0·95 amp. lamp to have a life comparable with the ordinary household lamp, and it was agreed by bulb makers that such a bulb having a life of 1,000 hours cannot possibly be made at an efficiency high enough to give the legal one candle-power minimum.

There could be no doubt that the use of white-frosted or yellow-tinted well glasses improved the lighting conditions under which the miner had to work. White-frosted well glasses reduced the intrinsic brilliancy of the source of light, and did undoubtedly diminish glare. As regards yellow-tinted well glasses, there seemed no doubt as to their efficacy, but no scientific explanation has yet been advanced as to why they should be so effective. Although they reduce the candle-power they appeared to increase the visibility. A possible explanation of this might be that they reduced glare by cutting out those rays which were least useful to the eye, and allow that portion of the spectrum in which visibility is highest, namely, yellow screen, to pass through. The theory that they cut out the ultra-violet light could be ruled out of court, as it had been proved by Verhoeff and Bell that only ultra-violet light of shorter wavelength than 3050 Angstrom units had any deleterious effect upon animal tissue. As clear glass 1/16th in. thick absorbed all rays below this wavelength, and as ordinary clear well glass was never less than $\frac{1}{4}$ in. thick, it seemed obvious that none of these harmful rays can reach the miner's eye even when clear well glasses are used.

(Mr. Sack's remarks were illustrated by a demonstration in the course of which the apparent candle-power of miniature lamps all working at 2 volts 0·95 amps., but run at various efficiencies, was illustrated, and the effects obtainable from gasfilled lamps of higher voltage also shown.)

Dr. MILES expressed his interest in the demonstration arranged by Mr. Sack. He thought, however, that this illustrated the force of Mr. Farmer's suggestions in regard to the desirability of frosting bulbs. Everyone would agree that an unscreened filament constituted a definite source of irritation, largely owing to the contrast between the bright point of light and the dimly lighted surroundings. The more completely the actual source could be screened from view the better it was for the workers. Yellow glass apparently had advantages, but did not serve as a means of diminishing contrast to any material extent; in this respect the frosted glass was more effective.

With regard to the influence of light on output, tests had been conducted over a considerable period in the particular colliery in which Mr. Farmer's experiments were carried out. The improved output resulting from better illumination had been maintained during this period. Similar evidence was available from another colliery where oil lamps had been replaced by acetylene lamps and a higher illumination obtained. He had recently come across an illustration of a lamp worked by compressed-air plant. It was stated that good illumination could thus be obtained with perfect safety. He would be glad to know whether anyone present had had experience of such lamps.

Mr. W. PLUMMER (Ceag Miners' Supply Co. Ltd.) read a communication dealing with the problem from the standpoint of the makers of miners' lamps. Mr. Farmer's paper rather left the impression that manufacturers had not given the subject the attention it deserved; he hoped to show that this was not the case.

That increased illumination brought in its train many beneficial results was true of all industrial operations, but especially so in coal mines. One could conveniently deal with lamps under two headings: (1) Design and (2) Maintenance in efficient condition. A question that at once arose in connection with Mr. Farmer's paper was "How many types of lamps were tried, and under what conditions?" It would appear that in studying after-images a standard or pillar type of lamp with a clear glass was used.

Some years ago, after experiments in conjunction with Professor R. V. Wheeler and the Ebbw Vale Co., the company with which he was associated had introduced the uranium-tinted well glass. This had the same characteristics as the translucent glass described in the paper, but absorbed much less light. Experiments in their own laboratory showed that visual acuity was increased. The ultra-violet rays from the blue end of the spectrum were absorbed, an important point which did not seem to have been considered by the investigators. This tinted glass was not an experimental glass and there were thousands in successful use.

And the candle-power of the bulb is small (generally 1 c.p. in a 2-volt lamp), every avenue offering even a slight increase in the ultimate illumination demanded, and had

received investigation by manufacturers. The standard lamp, such as was apparently examined by Mr. Farmer, left much to be desired. Experiments had been made with dioptric well glasses of the Holophane type (the prisms being inside so as to avoid collection of coal dust). Some excellent results, showing considerable improvements over other types, had been obtained, but the designs were not considered sufficiently advanced to be put upon the market just yet. With this type of well glass the position of the filament was important, and likewise in the standard plain type, as Mr. Farmer had pointed out. In the " Ceag " lamp arrangements were made to ensure filaments being in the right position, and lampmen were instructed how to effect this.

Mr. Plummer then went on to describe the pillarless lamp introduced by his firm, the amount of useful light being greatly increased by the removal of the four protector rods and the addition of a reflector. He had read with much interest the original report of the investigation showing the effect of increased candle-power in improving output. The lamp used by the experimenters was stated to give six times the light from the standard lamp, with a weight five times as great. His company had recently introduced a lamp, utilizing two standard accumulators yielding 4 volts. This lamp gave four times as much light as the standard lamp, with less than twice the weight. This lamp was also now being widely used. He mentioned these advances to show that manufacturers of miners' lamps had anticipated needs, and only the present financial resources of some collieries prevented their obtaining the full benefit of such advances.

He was somewhat surprised that no reference had been made to the cap lamp, which had many advantages. It was easy to design a reflector such that all light was usefully employed, and the eye was not subjected to irritating contrasts, the light following the wearer's eye. Whilst the hand lamp must be placed two feet from the swing of the collier's pick, the cap lamp was almost invariably much nearer the coal face, and in some cases the actual illumination might be over 100 times as great! The fact that the use of this lamp was chiefly confined to Scotland and parts of South Wales, though extensively employed in America, was apparently due simply to prejudice. Another recently developed lamp was of the swivelling type, designed to afford a direct concentrated beam on the work. Although still in the experimental stage, it was believed that this lamp was a step in the right direction.

Turning next to the question of maintenance, Mr. Plummer emphasized the importance of robustness and simple and easy cleaning, and mentioned that the " Ceag " lamp could be completely dismantled in less than 30 seconds. The use of a solid electrolyte (such as " Jellac ") did away with trouble due to corrosion of component parts. Standardization and absolute interchangeability was also important. This led to the vexed question of upkeep costs. His company arranged for all bulbs to be subjected to photometric tests before leaving the works. The bulb should give 1 candle-power for a period of approximately 600 hours. The use of efficient bulbs and the maintenance of candle-power were of obvious importance; it was unfortunate that some collieries were inclined to use lamps of relatively low candle-power, owing to the slightly longer life. In some cases this led to a diminution in candle-power of 30-40 per cent. Dr. Llewellyn had commented on this point last year, pointing out the short-sightedness of using inferior bulbs, which nullified the advantages of the electric lamp.

In conclusion, Mr. Plummer emphasized the importance of training lampmen. It was the practice of his company to give these men at least a fortnight's training in their own works, followed by another fortnight in the lamp cabin of some older and well-organized institution. The maintenance of efficient conditions was also promoted by periodical visits of inspectors and the distribution of leaflets explaining in simple terms how candle-power may be measured, and the working of accumulators, etc. He hoped, therefore, that Mr. Farmer would agree that research conducted by lamp manufacturers was at least as active as in other industries. Co-operation between users and manufacturers would materially assist progress towards further improvement.

Mr. S. J. WRIGGLESWORTH (Messrs. Oldham & Sons Ltd.) said that he had been much interested to hear the various points raised in the discussion, and in particular the remarks in connection with bulbs and their efficiency. Whilst his firm were makers of electric safety lamps, as, of course, was well known, they did not manufacture bulbs themselves; but as the most efficient bulb would be of little use with an inefficient accumulator they had concentrated on definite lines of improvement in this direction. In the first place, he should explain that they had never had any trouble from a plate point of view, and, therefore, the improvements that had to be effected applied to the accumulator container. In this direction the latest improved form of accumulator known as the snap-lid type had certainly proved of immense value towards better illumination of the standard 2-volt miners' lamp. This had almost superseded the old type cell with sealed-on lid. With the sealed-in accumulator it was found that neglect, or inattention from the people whose job it was to attend to it, caused the efficiency to be seriously affected. If the cells were not washed out a deposit formed in the bottom of the cell, and this being of a metallic substance, was apt to cause a serious short, and thus impair the efficiency of the accumulator. With the new type of cell this was entirely obviated. There was no excuse for neglect of the accumulator, and as a matter of fact its adoption had proved an incentive for better attention. So it was claimed that indirectly, whilst they might not have improved the candle-power obtaining previously, they had made great steps towards sustaining the candle-power in as high a state of efficiency as when lamps and accumulators are perfectly new. This, it was suggested, had proved a good step towards better illumination.

In view of the interest the 4-volt lamp had caused, he might say that immediately a lamp of the 4-volt variety was suggested by authorities and others interested, his firm set out to make a lamp of this type, being as near as possible a replica of our 2-volt lamp, the main idea being for convenience and assembly, many of the parts being standard and interchangeable in each lamp.

However, experience at present suggested that this form of lamp was not popular. One cause might be the weight, and another the fact that the expense of these lamps for bulbs and spares (namely, plates) would be double the cost of the ordinary 2-volt lamp; hence many who had seen it, whilst not condemning the lamp, had not shown any great enthusiasm for it. In addition, just as many lamps would be required for the 4-volt variety were a change-over contemplated of the present existing installations, and the cost might also have had a considerable bearing on the question; so that the time for the *general* use of the 4-volt lamp did not appear to be yet. On the other hand, the 2-volt electric safety lamp, which gives excellent results, with its low-maintenance costs and its accepted portability, had proved efficient from every point of view, and, as previously mentioned, had made definite progress in the direction of better illumination, and wherever adopted had met with almost universal popularity.

Dr. R. LESSING referred to Mr. Farmer's statement that when the filament was placed lengthwise in relation to the coal face better illumination was obtained than when it was put endwise. It occurred to him that possibly the coal seam itself (i.e., an alternate series of dull and bright coal) had something to do with this effect. Bright coal had a highly reflective mirror-like surface, and in considering the design and use of lamps this seemed to be worth consideration.

Mr. E. A. HAILWOOD (Messrs. Ackroyd & Best Ltd.) remarked that the impression given by some of the contributions to the discussion was that the old flame lamp was disappearing, and that interest centred entirely round the electric lamp. In this connection a study of the Reports of the Mines Department, dealing with cases of nystagmus and accidents in mines, did not support prevalent ideas. If it were true that nystagmus was due to inadequate illumination, and that illumination was

improved by the general use of electric lamps, one would naturally have thought that nystagmus should now be a thing of the past. But this was not so. The average number of cases of the disease during the years 1908-1913 was roughly 1,500, and it was now 11,000. Similarly, if accidents could be eliminated by better illumination, the number of accidents should have diminished, but instead of that they had increased. In 1908 there were 140,000, but by 1913 they had risen to 196,700. The number dropped in 1921, which was the year of the big strike, but in 1923 they went up to 246,700.

It seemed to him, therefore, that there was something wrong in the contention that the use of electric lamps diminished nystagmus. He had on many occasions been down a mine with a flame lamp, and he had been asked by managers to make it burn in places where it would not burn because of the blackdamp, etc. The smoking or dimming of the lamp was one of the first signs of the presence of gas or blackdamp. Sometimes when a lamp began to smoke a miner thought that it was the fault of the lamp, and did not realize the true cause, i.e., the presence of gases; but if every lamp began to smoke the men would know that there was something wrong with the atmosphere and act accordingly.

The electric lamp did not enable these atmospheric changes to be detected, and it seemed to him that there was a danger that the atmosphere would be allowed to become worse, perhaps to the extent of one, two or three per cent. contamination, and that continually breathing this atmosphere might have a prejudicial effect on health and eyesight. The question was whether in obtaining one candle-power with electric lamps one might not be doing more harm than good, because of these other disadvantages. The yellow glass did not materially diminish the brightness of the filament, which must be a trouble to the miner. Personally he was far more comfortable with the ordinary flame lamp.

It would, however, interest the meeting to know that makers of flame lamps were also trying to introduce improvements. In illustration of this, Mr. Hailwood exhibited to the meeting a new form of flame lamp which had interesting features and was quite a new departure. With the old lamp the amount of free space through which the illumination could pass was limited, and he was quite satisfied that with the new lamp he could obtain three candle-power. It was very easy to adjust the dome or the wick. He could also apply white reflectors to increase the illumination in front of the lamp, or could embody in the design a translucent glass if desired.

Mr. COOKE (B.E.S.A.) briefly referred to the questions raised in regard to the efficiency of bulbs for miners' lamps. It was hoped that in the near future a specification would be prepared for the rating of miniature lamps, and this no doubt would help to bring about improvements.

The CHAIRMAN (Mr. C. C. Paterson) said that in his experience the necessary diffusion of light could be obtained without any very material diminution in illumination. In fact he thought that this diminution need not be psychologically perceptible. The alteration of what was practically a point source into one with a luminous area of two to two and a half square inches was a distinct advantage, outweighing the relatively small loss of light. The question of the effect of the change on the shadows cast by the lamp, e.g., in revealing small ledges and projections, had also to be considered. With regard to the effect of tinted glasses it was necessary to remember that two colours which were only slightly different might be presented in marked contrast by changing the nature of the light shining on them.

Mr. HENRY F. JOEL, in a written communication received since the meeting, comments on the figures quoted by Mr. Hailwood. He understood that the apparent increase in the number of cases of nystagmus and accidents was due to stricter supervision and application of the Regulations of the Authorities, and the necessity of now reporting all cases, however trivial. Nystagmus was recognized 20 years ago as a serious disease arising from the strain on the eyes caused by men working with the low candle-power oil lamps, often with smoky lamp-glass, and furnishing only 0·1 to 0·2 candles.

Mr. J. S. DOW (*communicated*): There seems to be a general impression that a yellow-tinted glass is beneficial, but the explanation is not clear. There is probably something in the suggestion that the yellow colour shows up more clearly the contrast between the black coal and the bluish shale mixed with it. I also long ago formed the impression that for many eyes yellowish light, and especially exclusion of blue light, is favourable to sharper images of objects seen at distances exceeding a few feet, though this may not be true of very close vision. This better definition is apparently a consequence of the want of achromatism of the human eye. At the very weak illumination prevalent in coal mines, falling on surfaces with a very low coefficient of reflection, the eye is in a highly "dark-adapted" state. The expansion of the pupil aperture renders it particularly susceptible to glare, and also probably accentuates any optical defects in the eye (in the same manner as a wide stop on a camera lens). This latter condition would serve to accentuate lack of definition owing to want of achromatism of the eye, and render the benefit of yellow light still more marked.

There is also another phenomenon of the dark-adapted eye, which may explain in a large measure why yellow light is apparently beneficial in cases of nystagmus, as well as in reducing glare. A well-known characteristic of the dark-adapted eye is that the central portion of the retina is still sensitive to yellow light, but comparatively insensitive to the blue end of the spectrum, whereas for the peripheral region the exact contrary is the case. Even a feeble blue light, seen out of the "tail of the eye," appears as a perfect "blaze." It is natural to suppose, therefore, that the yellow glass somewhat reduces the apparent luminosity and glare of the light source, seen by oblique vision. It may have an even more important influence in compelling the miner to use the central region of the retina and look straight at the object viewed, thus checking the rolling motion of the eyeball characteristic of nystagmus.

The Illuminating Engineering Society in Germany

Some Recent Events

We notice that Herr Alfred Bosenburg recently gave an illustrated lecture before the German Illuminating Engineering Society, in which some 200 illustrations of early illuminants and fittings were shown. Herr Bosenburg is himself the author of a very fine historical work on lighting fittings, to which reference was made in one of the earliest issues of *The Illuminating Engineer*, and is the possessor of a very fine collection of these early lamps. Reference was also made to the collection at the German Museum of Hygiene and the series of coloured pictures (with a few exceptions reproductions of the original pieces in Herr Bosenburg's collection) incorporated therein. The pictures shown at the meeting illustrated the use of pine splinters etc. in domestic use and in primitive workshops, examples of oil lamps for churches etc. being described later.

At the meeting of the German Illuminating Engineering Society on Feb. 4th several communications were read. These included papers by Herr W. Licht on "A Hundred Years of Gas Lighting in Berlin" and by Herr E. Alberts on "High-pressure Gas Lighting or Intensive Low-pressure Gas Lighting?" The latter subject should give rise to an interesting discussion as the relative merits of these two methods are now exciting much attention, in view of the marked progress made in low pressure gas lighting during recent years.

We also observe in *Licht und Lampe* a complete syllabus of the course of lectures for employees of electric light undertakings arranged by the German Illuminating Engineering Society in co-operation with the Union of Electric Generating Stations, referred to in our last issue.

A Self-Starting Tungsten Arc Lamp

By Dr. N. A. HALBERTSMA

FOR experimental work in optics, for microphotography, and for dark field illumination in the microscope, a light source of small size but of high and uniform brightness is needed. Such a source is realized, in the form of a luminous disc, by the positive crater of the carbon arc. But success in optical work depends largely upon the exact focussing of the light source, and it will be easily understood that the continuous burning away of the carbon electrodes presents difficulties in this respect. Carbon arcs used for some forms of optical work have to be very carefully regulated, and any automatic apparatus for this purpose has to conform with the highest demand of accuracy.

As a result of a search for other materials suitable for the maintenance of an arc, without consumption of the electrodes, tungsten was found to be quite a suitable material, although the melting point of this metal (about 3,500° K.) is much lower than the temperature at which carbon evaporates in the arc without melting.

FIG. 1.—Photograph of Arc formed between Tungsten Electrodes.

Small spheres of tungsten, mounted close to each other, become incandescent when an arc is produced between them (Fig. 1), and this arc can be maintained for an indefinite time if it is enclosed in a bulb filled with an inert gas. If there be any evaporation of tungsten at all the metal is likely to be deposited on the opposite electrode. The arc itself is practically non-luminous.

The incandescent spheres act as circular light sources of uniform brightness. One of them may be placed in such a way that the other one is shielded, and thus a lens may be illuminated by what may truly be called a point source of light.

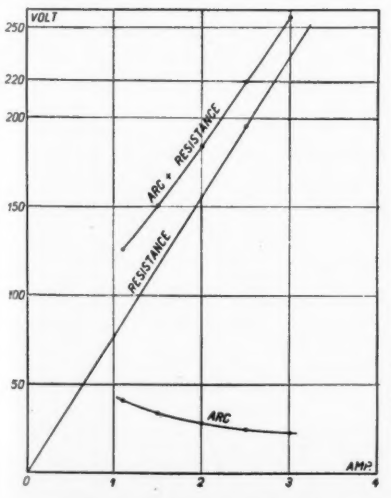


FIG. 2.—Showing Characteristics of Tungsten Arc.

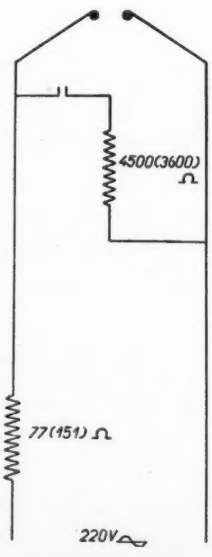


FIG. 3.—Diagram of Connections.

The tungsten arc presents the electrical characteristics of an arc, as the following table shows :—

Volt	Amp.	Apparent Resistance	CP	CP/in²
34·0	1·5	22·70	59	6,700
28·5	2·0	14·25	73	8,300
25·0	2·5	10·00	87	9,900
22·5	3·0	7·50	99	11,300
20·5	3·5	5·85	110	12,500

As the tungsten arc has to be fully enclosed ordinary methods of striking the arc cannot be applied. Some form of thermostat may be used to separate the tungsten spheres if they are initially in contact, but it is difficult to keep the electrodes accurately spaced in this way. The discharge between the tungsten electrodes may also be started by the thermionic emission of an incandescent coiled tungsten filament in close proximity to the arc. This method requires a special starting resistance and the manipulation of a special starting switch.

The design of the self-starting tungsten arc lamp developed in the Philips Electric Lamp Works enables the manipulation of this lamp to be greatly simplified. It operates on the following principle, as illustrated by Fig. 3.

After connecting the lamp to a 220 volt A.C. supply the full voltage is applied both to the tungsten electrodes and to the starting electrodes. At these electrodes only a luminous discharge occurs, whereby the current is limited by a 4,500 ohm resistance to a value of about 6·7m. amps. It is this luminous discharge which ionises the gas and thus starts the arc between the tungsten electrodes. The current in the arc immediately reaches the maximum value, as limited by the 77 ohm stabilizing resistance in series with the arc. A voltage drop of nearly 200 volts is then caused by the resistance (the voltage of the arc proper being about 25 volts), hence the voltage between *a* and *b* becomes too low to maintain the luminous discharge. Accordingly the starting discharge is extinguished automatically as soon as the arc is started.

It will be remembered that the Nernst lamp also had a starting device, a heating element, which was switched off by an electro-magnetic relay as soon as the electric current started to flow through the Nernst glower. In the self-starting tungsten arc lamp a similar operation is carried on without any relay and switches, simply by an alteration of the voltage drop in the two circuits of the lamp.

The self-starting tungsten arc lamp is made in two sizes, one for 1·3 amps. and the other for 2·5 amps., both for A.C. voltages of 200 and more. These sizes were found to cover the demand for a small-sized light source of high intrinsic brilliancy. These lamps yield 40 and 80 c.p., respectively. It should not be overlooked that for the special purposes for which these lamps will be used the candle power is not of great moment, and that it is chiefly the *brightness* and its equal distribution over the area of the source that are important. As the tungsten spheres

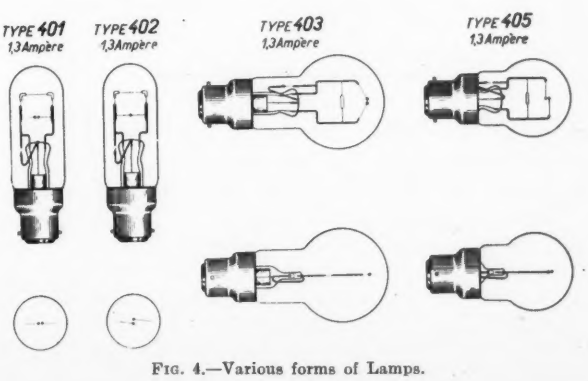


FIG. 4.—Various forms of Lamps.

have a diameter of 1 and 1·8 mm. (respectively 0·07 and 0·07 in.), the brightness is about 10·000 c.p. per square inch or 15·7 c.p. per square mm.

In Fig. 4 the different types of the Philips tungsten arc lamp are shown. No. 401 is a vertical type with the spheres placed side by side, No. 402 a vertical lamp with the spheres placed one behind the other in order to shield off the light of one of the spheres.

No. 405 is the corresponding type for use in a horizontal position.

By using a small diameter cylindrical bulb for the vertical types, and by placing the electrodes close to the front wall of the bulb in the horizontal lamps, advantage can be taken of short focus condensing lenses.

The stabilizing resistance which has to be used in conjunction with the Philips tungsten arc lamp is built in the form of a lamp with a cylindrical bulb, burning with the cap down (Fig. 5). It should be noticed, however, that this bulb is not closed, but open at the lower and upper ends, in order to produce a strong circulation of heated air and a good cooling effect on the resistance elements in the bulb. The use of a resistance of just the right size is important, as the tungsten arc lamp should only burn at the exact amperage for which it has been made.

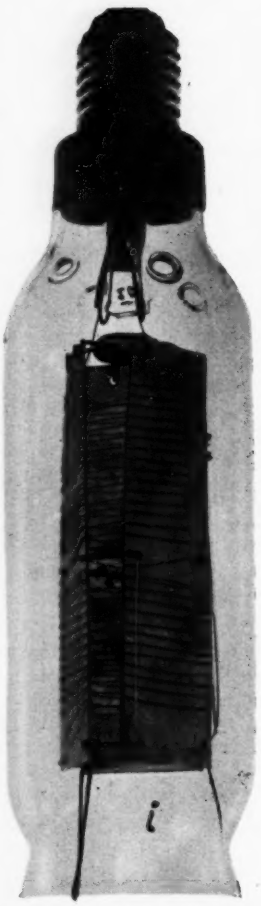


FIG. 5.—Showing construction of Stabilizing Resistance.

Contrary to the experience with the ordinary tungsten incandescent lamp, the bulb of the tungsten arc lamp blackens not only when it is overrun, but also when it is underrun. Hence reducing the amperage of the lamp does not make the lamp live longer.

There is still another point in which the behaviour of the tungsten arc lamp differs from that of the ordinary tungsten lamp. The latter shows a variation of nearly 4 per cent. in its candle power for 1 per cent. variation of voltage. The tungsten arc lamp has a variation of 0·8 per cent. only in candle power for 1 per cent. variation of voltage. This constancy of light, which has heretofore been unknown with electric illuminants, may prove to be very useful for exact microphotographic exposures and for film-copying apparatus, as well as having possible advantages in photometric work.

The Advantages of Low Voltage Lamps

In a contribution to the Bulletin of the Société Française des Electriciens, M. Bossu discusses the use of lamps on special circuits, such as those in which lamps are charged by a battery of accumulators in parallel with a dynamo. A variety of practical cases is discussed, the best voltage in each case being deduced. Generally speaking it is an advantage to keep the pressure relatively low as in this way more robust and efficient lamps can be used.

British Standard Specification for Industrial Reflector Fittings for Electric Lighting. (No. 1)*

(No. 1.—Open Dispersive (Vitreous Enamel) Type for Direct General Lighting for use with Gasfilled Electric Lamps complying with the requirements of B.E.S.A. Specification No. 161—1924.)

GENERAL.

1. This Specification covers seven sizes of British Standard Industrial Circular Reflector Fittings for Direct General Lighting, No. 1, Open Dispersive Type, for use with gasfilled lamps. They are designated according to the nominal consumption of the lamps for which each is suitable, as set out, with some other details, in the Table below: —

1	2		3		4		5	6	7
Designation	Nominal Diameter.		Minimum effective interior diameter.		Minimum thickness of steel used for making Reflector Fitting.		Particulars of suitable lamps complying with the requirements of B.E.S.A. Specification No. 161–1924.		
							Mean Light Centre Length.*		Type of Lampholder.
	in.	† cm.	in.	† cm.	in.	† mm.	mm.	in.†	
For 40 watt lamps	10	25·4	9¼	23·5	·018	·46	85	3·4	B.C.
For 60 watt lamps	12	30·5	11¼	28·6	·018	·46	85	3·4	B.C.
For 100-150 watt lamps ..	14	35·6	13¼	33·7	·018	·46	120	4·8	B.C.
For 200 watt lamps	16	40·6	15¼	38·7	·018	·46	150	5·9	E.S.
For 300 watt lamps	18	45·7	17	43·2	·028	·71	180	7·1	G.E.S.
For 500 watt lamps	18	45·7	17	43·2	·028	·71	205	8·1	G.E.S.
For 1,000-1,500 watt lamps	20	50·8	19	48·3	·028	·71	250	9·9	G.E.S.

* The light centre length tolerances allowed in B.E.S.A. Specification No. 161–1924 do not apply in connection with the tests referred to in Clauses 4, 5 and 6.

† These equivalent dimensions are approximate only.

The Reflector shall be fitted with a lampholder of the type given in Column 7 of the Table, and shall satisfy the requirements of this Specification when a gasfilled lamp of the size given in Column 1 of the Table is used in the holder provided. All lampholders shall comply, in so far as is necessary to secure interchangeability of lamps, with the dimensions given in the appropriate B.E.S.A. Specification.

Note.—Under Licences obtained from the Main Committee of the British Engineering Standards Association, the British Standard Mark B.E.S.A. may be marked on the Reflector Fitting by British manufacturers to show that the Reflector Fitting complies with the British Standard Specification. Reflector Fittings so marked shall in addition bear the number and year of issue of this Specification, i.e., 232—1926.

Particulars of the conditions under which Licences are granted may be obtained from the Secretary of the British Engineering Standards Association, 28, Victoria Street, S.W.1.

MATERIAL.

2. Unless otherwise specified, the Reflector shall be made of steel of not less than the thickness given in Column 4 of the Table in Clause 1, and shall be coated inside and outside with not less than three uniform smooth coats of vitreous enamel.

DIMENSIONS.

3. The effective interior diameter of the Reflector Fitting, i.e., the diameter measured within the mouth, shall be not less than that given in Column 3 of the Table in Clause 1.

LUMINOUS OUTPUT.

4. The total luminous output of the combined Reflector Fitting and lamp shall be not less than 60 per cent. of the luminous output of the lamp alone.

* *Specification issued January, 1926. Published by permission of the British Engineering Standards Association, 28, Victoria Street, London, S.W.1; from whom copies of the Specification may be obtained. Price 1s. net; post free, 1s. 2d. The Association desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the apparatus herein referred to, but does not purport to comprise all the necessary provisions of a contract.*

The test lamp for the purpose shall be a normal type gasfilled lamp, with clear glass bulb, complying with the requirements of B.E.S.A. Specification No. 161—1924, of the size given in Column 1 of the Table in Clause 1, and having a filament free from sag. The light centre length shall be as given in Columns 5 and 6 of the Table, the lampholder being in the normal fixed position in the Reflector Fitting.

Note 1.—Measurements of luminous output may be made either by means of a photometric integrator or by a point-to-point method (see Appendix).

Note 2.—An efficiency of about 70 per cent. was obtained with this type of reflector under the conditions which were usual formerly. The conditions have been altered in order to reduce the amount of glare from the Reflector Fitting, and so comply with the recommendations contained in the Second Report of the Departmental Committee on Lighting in Factories and Workshops, 1921.

Distribution of Light.

5. The distribution of light from a Reflector Fitting intended for use with a 100-watt lamp or over shall, when the Reflector Fitting is fitted with the appropriate lamp, be such that the ratio of the maximum candle-power in any direction within 15° of the downward vertical axis to the average of the candle-powers at 25°, 35°, and 45° from the downward vertical axis is not greater than 1·35.

Note.—The distribution of light herein contemplated is suitable for use in installations in which the spacing of the lamps is 1½ times the height.

Angle of Cut-off.

6. When the Reflector Fitting is fitted with the appropriate lamp as defined below, no part of the filament shall be visible when viewed from a point in any direction making an angle exceeding 70°* from the downward vertical axis of the Reflector Fitting.

The test lamp for the purpose shall be a normal type gasfilled lamp, with clear glass bulb, complying with the requirements of B.E.S.A. Specification No. 161—1924, of the size given in Column 1 of the Table in Clause 1 and having a filament free from sag. The light centre length shall be as given in Columns 5 and 6 of the Table, the lampholder being in the normal fixed position in the Reflector Fitting.

* This figure complies with the Recommendation of 20° from the horizontal for light sources at distances of not less than 6 feet, contained in the Second Report of the Departmental Committee on Lighting in Factories and Workshops, 1921, but may be altered later.

Selection for Testing

Note.—Agreement should be reached before the order is placed in regard to the carrying out of tests for compliance with this Specification.

In view of the cost of carrying out such tests, it is not expected that they will be called for except in the case of purchases of 200 reflectors or over. It is essential, therefore, that the manufacturers should have their products tested sufficiently frequently to ensure that they are in accordance with the Specification. Evidence of such tests should, as a general rule, satisfy the purchaser as to the quality of the reflectors.

Selection for Testing of Reflector Fittings under Clauses 1, 2, 3 and 6.

7. For test under Clauses 1, 2, 3 and 6, Reflector Fittings shall be selected at random as follows:—

From batches of 200 to 500 Reflector Fittings: 5 per cent. (fractions being neglected).

From batches of more than 500 Reflector Fittings: 2 per cent. plus 15 (fractions being neglected).

If any of the Reflector Fittings selected fail to pass the requirements of Clauses 1, 2, 3 or 6, they shall be deemed not to have satisfied the requirements of this Specification. If more than 10 per cent. of those selected fail to pass such requirements, two further selections of a similar number shall be made; if more than 10 per cent. of either of these selections fail to satisfy the requirements, the whole batch shall be deemed not to comply with this Specification.

Selection for Testing of Reflector Fittings under Clauses 4 and 5.

8. For test under Clauses 4 and 5, Reflector Fittings shall be selected at random as follows:—

From batches of 200 Reflector Fittings and over: 1 per cent. (fractions being neglected).

If the average of the values of the luminous output of the Reflector Fittings tested does not satisfy the requirements of Clause 4, or the average ratio indicating the distribution of light does not satisfy the requirements of Clause 5, two further selections of a similar number shall be made. If the results from either of these selections do not satisfy the requirements of Clauses 4 or 5, the whole batch shall be deemed not to comply with this Specification.

Appendix

Methods of Efficiency Measurement.

(*a*) *Photometric Integration Method.*—When a photometric integrator is used, the diameter (or the least distance between opposite sides in the case of a non-spherical integrator) shall be not less than four times the maximum diameter of the Reflector Fitting. All externally visible opaque parts of the lamp or Reflector Fitting and its support shall be whitened, or covered with a white material, provided that the amount or distribution of the light flux from the lamp or Reflector Fitting is not thereby affected.

(*b*) *Point-to-Point Method.*—When a point-to-point method is used, the distance between the light centre of the lamp and the photometer head shall be not less than eight times the diameter of the Reflector Fitting. The total flux shall be deduced from measurements of candle-power in two vertical planes at right angles to each other, one of which includes the axis of symmetry of the lamp filament system. Measurements shall be made in each plane on one side of the downward vertical axis only, and at the following angles from that axis, viz: (i) at 0°, 10°, 20° . . . 180°, or alternatively (ii) at the 20 Russell angles given in the following table. In the latter case the arithmetical average of the candle-power values shall be taken as the mean luminous output.

Russell Angles.

Measured from the Downward Vertical Axis.

18·2°	56·6°	81·4°	104·5°	130·5°
31·8°	63·3°	87·1°	110·5°	138·6°
41·4°	69·5°	92·9°	116·7°	148·2°
49·5°	75·5°	98·6°	123·4°	161·8°

Obituary

Mr. Leonard G. Tate.

We record with great regret the death of Mr. Leonard G. Tate, for many years secretary of the Electrical Contractors' Association. Mr. Tate had a somewhat varied career, which brought him into touch with many different aspects of the electrical industry. His early training was with the Pilson Joel and General Electric Engineering Co., where he was associated with the lamp department. He subsequently accepted the management of the lamp department of the Schuyler Electric Company, in Hartford, Conn., U.S.A. In 1899 he became associated with the Brush Electrical Engineering Co. Ltd., and in 1892 he joined Mr. Leslie Fuller in founding the business of Fuller and Tate. This business he subsequently carried on alone as Leonard G. Tate and Company, Electrical Contractors. From 1902 onwards he was associated with the original National Electrical Contractors' Association, and assisted in the incorporation of the present Association. After becoming honorary Secretary of the Association in 1915, he became the whole time general secretary in 1918, when he severed his connection with the firm bearing his name.

Mr. Tate devoted himself whole-heartedly to the welfare of the Electrical Contractors' Association, and in 1925 he was presented with a silver salver and cheque in appreciation of his services for the past 21 years. There can be no question that he contributed very greatly towards the raising of the status of electrical contractors, to whom his death comes as a severe loss. He will also be keenly regretted by his many friends in the electrical industry with whom his quiet geniality and broadminded outlook made him very popular.

Two-Filament Headlight Lamps

AN interesting attempt at the solution of the headlight problem is now announced from the United States. It has been recently pointed out in this journal that some difference of opinion exists in regard to the advisability of completely switching off the driving beam when approaching another car; this relieves the oncoming driver of the glare from the opposing headlight, but the sudden transition to darkness is liable to cause accidents.

The American solution lies in the production of a double or alternative beam by means of two filaments, differently situated within the lamp-bulb. With the filament exactly at the focus of a parabolic reflector a round spot of light is produced which may be elongated sideways into an oval (giving sufficient spread to the beam) by means of a fluted cover. If the filament is slightly below the focus the beam is extended upwards; if, on the other hand, the filament is above the focus the beam is depressed. Thus, by having two filaments, one slightly above and one slightly below the focus, and by suitably adjusting the tilt of the headlight we can obtain two oval beams of light, the first just touching the level of headlamp centre, the other considerably below it. The filaments can be controlled by a switch so that the motorist can, when approaching another car, or in well-lighted roads where a powerful horizontal beam is unnecessary, switch on the depressed beam only. In this case the drawback of direct light entering the eyes of the driver of an approaching car is eliminated.

In the illustration of the two-filament lamp the bulb carries a number of concentric corrugations, designed to assist the spreading of the beam. The spacing between the two filaments of the standard lamp (Mazda lamp, No. 1110) has been very carefully determined, and amounts to only 9/64ths of an inch. The idea of the depressible beam has received powerful endorsement in the United States, being approved by the Committee of the Illuminating Engineering Society (U.S.A.) on Motor Vehicle Lighting, in co-operation with representatives of the Society of Automotive Engineers and the Bureau of Standards. The Eastern Conference of Motor Vehicle Administrators, representing nearly 40 per cent. of the car registration of the country, has likewise approved the idea and agreed that in general equipment should be designed for a tilt of about two and a half degrees. We understand that special headlight lamps of this type are to be developed by the British Thomson-Houston Co. Ltd. in this country.

Another convenient device recently introduced to enable purchasers of cars and dealers to adjust headlights properly is a form of standard screen. This is mounted on a wall 25 feet from the headlights, so as to receive the beam, and carries two black tapes, one stretched at the height of the headlamp centres, the other below at a distance required for loading allowance (the latter being specified for typical types of cars).

The Coming of the Electric Age

ON Thursday afternoon, the 21st January, sixty-five members of the Glasgow Branch of the Electrical Association for Women attended a lecture and demonstration of Modern Electric Lighting at the Scottish Electric Lighting Service Bureau, Glasgow, the President, Lady Belhaven, occupying the chair.

The District Engineer of the Bureau, Mr. Henry E. Hughes, delivered a lecture on "The Coming of the Electrical Age," in which he accentuated the importance of applying the right principles in electric lighting, and outlined and demonstrated what these principles were. Home lighting was naturally what the ladies chiefly wished to know about, and a demonstration of the lighting of the principal rooms in the home was given by Miss K. St. Clair Lindsay, in which surprise was caused by the quick change of furnishings in the alcove used for this demonstration.

After tea had been served, some wonderful shop-window colour-lighting effects were shown, and the many other equally interesting lighting exhibits explained.

It was felt and expressed by Lady Belhaven that the afternoon had been an extremely profitable one for herself and, she felt sure, for the other members of the Association.

In the evening a further party of twenty-five of the E.A.W. members attended the Lighting Service Bureau, and the programme was repeated throughout, with signs of most beneficial results.

Propaganda Lectures on Illumination

DURING the past month quite a number of different lectures and addresses have been delivered by Mr. Leon Gaster. On January 23rd, at the Jewish Institute (Mulberry Street, Commercial Road), he lectured on "Ideal Requirements and Practical Solutions of the Lighting of Clothing Works," Colonel Sir Frederick Nathan, K.B.E., presiding. This subject was one of local interest, as there are many clothing factories in the vicinity. On January 28th he followed this up by an address at the Jews' Free School Old Boys' Club (Middlesex Street) on "The Hygienic and Economic Value of Good Illumination." There was an excellent attendance, and his audience, though young, showed great keenness in discussing the points raised. The remarks on the lighting of schools were received with special interest. (It may be mentioned that last November Mr. Gaster also lectured before the Old Boys' Club in the Mile End Road. On this occasion Lieut.-Colonel J. S. Marks presided.) All these addresses were fully illustrated by lantern slides, both gas and electric installations being shown.

On February 1st, at the luncheon of the Croydon Chamber of Commerce, he gave an address on "The Commercial Value of Good Lighting," which was of a chatty character. There was again a large and appreciative audience, who enjoyed the many references to matters of local interest.

Finally, on February 3rd, there was a lecture before the London Association of Welfare Supervisors, also illustrated by many views of factories, pictures showing the difference between good and bad lighting, and tabular data relating to the work of the Home Office Departmental Committee on Lighting in Factories and the American Codes of Industrial Lighting being shown. In most of the above addresses the value of good lighting in the interests of health and safety formed a feature, while at Croydon its advantages from a business standpoint were emphasized.

Electrical Developments in Russia

Not a great deal of first-hand information is available in regard to electrical developments in Russia, but the position appears to be extremely interesting, and should be watched by British engineers. Papers presented at the World Power Conference in 1924 forecasted the erection of generating works on a big scale. An informative article in *The Electrical Review* a few months ago* described the amalgamation of electrical manufacturing concerns into a State Electrical Trust, which is seeking the aid of foreign firms. Apparently Swedish firms are already participating, and negotiations have been proceeding with the A.E.G. in Germany by which the patents and technical information of the latter are placed at the service of Russian electrical engineers; the General Electric Co. of New York is also said to be participating in the arrangement. It is also stated that the Russians intend to enter into an agreement with the International Glow-Lamp Trust, for which negotiations are now proceeding. If the plans in prospect are carried into effect Russia will evidently be a large purchaser of electrical goods for some years to come. The whole situation is of great interest and it is to be hoped that firms in this country will not overlook the possibilities.

* October 30th, 1925.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society; and is based on outside contributions.)

Some Notes on Electric Lamps

No. 10

TRACTION LAMPS

By W. J. JONES, B.Sc., A.M.I.E.E.

(E.L.M.A. Lighting Service Bureau).

ELECTRICAL illumination in vehicles contributes much to the comfort of the travelling public, for it permits some occupation to be pursued en route, and in the event of accidents limits the risk of conflagration. Vibration constitutes one of the greatest difficulties which must be overcome in lighting for traction purposes; in addition to heavy jerks during the period of starting and stopping, or during shunting, disturbances at a higher frequency present yet greater difficulty. A study of the nature of these vibrations is a fascinating one, and a quantitative analysis of the magnitude and direction of these more or less continuous vibratory conditions would prove of great value, while a convectorial analysis of these disturbances would probably indicate that the chief axis of propagation varies according to the method of springing used for the coaches.

When the carbon lamp was introduced it was found to have sufficient ruggedness to withstand the complex mechanical and electrical conditions met with on traction systems, but a few years elapsed after the introduction of the tungsten lamp before it, too, could be designed to give satisfactory service under these conditions; indeed, not until special lamps were designed for the purpose.

It has been suggested by engineers that this vibration at a high periodicity produces a fatiguing effect on the filament out of all proportion to the magnitude of the stresses involved. (That similar fatigue is experienced in all metals when subjected to vibratory conditions is well known.)

It is proposed to confine the remarks in this note to the special design of lamps used on trams and electric trains where four or five lamps are run in series off a high voltage circuit of 400-600 volts. Such lamps must possess great ruggedness, and the modern traction lamp is the result of prolonged research. In practice, the filament of traction lamps is suspended upon springy supports at smaller distances than in the case of an ordinary lamp. The more frequent supports have the effect of reducing the unsupported weight of filament and mitigates the possibility of adjacent lengths of filament touching when subjected to considerable shock.

When lamps are connected in series it is important to ensure that they are designed to take the same current and to ensure uniformity of the characteristics of the lamps in use. With a view to ensuring this, a committee consisting of representatives of the various tram and rail authorities, etc., met to prepare a standard specification for Traction Lamps. As a result of these deliberations the British Engineering Standards Association have published a supplement to Specification 161, setting out a schedule of dimensions and electrical data. Standard lamps are made in four voltages, 100, 110, 120 and 130, and these voltages will be found to meet most of the requirements in this country. In view of the variation in voltage on a traction system, lamps of that standard voltage nearest to the voltage obtained from the calculation—

$$\frac{\text{"Estimated Average Voltage of System"}}{\text{Number of Lamps in Series}}$$

will be found suitable.

Since the current passing through the lamp is such an important matter in series working, limits for the volts across the lamp at the rated current are given. This will enable the satisfactory substitution of fresh lamps without causing undue disturbance of electrical energy consumed by the other lamps in series.

It is noted in the specification that although four voltages have been included to cover existing practice, it is hoped that by careful co-operation it will be found eventually possible to use one standard voltage only. Initial efficiency in terms of lumens per watt and watts per spherical candle is also given.

It is hoped that the facilities that are now available for obtaining such standard lamps will help materially in the improvement of the illumination in public vehicles. Good lighting is one of the improvements which could be effected immediately in most cases and be much appreciated by the travelling public as an interim measure while other improvements are perhaps more slowly introduced.

EXTRACTED FROM SUPPLEMENT TO B.E.S.A. 161 FOR TRACTION VACUUM TYPE LAMPS (SERIES BURNING).

Rated Volts	Rated Current	Rated Watts	Volts at Rated Current. Max.	Volts at Rated Current. Min.	Initial Efficiency. Lumens per watt. Rated	Lumens per watt. Max.	Lumens per watt. Min.	Watts per Mean Spherical Candle. Rated	Watts per Mean Spherical Candle. Max.	Watts per Mean Spherical Candle. Min.
100	·27	30	105·0	95·0						
	·35	40								
110	·27	30	115·5	104·5						
	·35	40								
120	·27	30	126·0	114·0						
	·35	40								
130	·27	30	136·5	123·5						
	·35	40								
					6·79	7·35	6·31	1·85	1·99	1·71

Developments in Miners' Lamps

(Notes on Exhibits at the Meeting of the Illuminating Engineering Society, held at the House of the Royal Society of Arts, at 7 p.m., on Thursday, January 21st, 1926)

FOLLOWING the discussion at this meeting (see pp. 37-42) a number of miners' lamps illustrating recent developments were exhibited.

"Ceag" Lamps.

Mr. W. Plummer showed a variety of lamps having interesting features. Amongst these was the new "Ceag" 4-volt lamp, stated to give 4 c.p. in all directions, with a weight of 10 lbs. 4 ozs. This lamp has already been illustrated and described in this journal,* and likewise the standard form of pillarless lamp made by this firm. The other forms of lamps shown had novel features.

The 4-volt Lamp.—Designed to meet the demand for a lamp giving more light—the "Ceag" 4-volt lamp admirably fulfils the requirements. Although less than twice the weight of the 2-volt lamp, it gives more than four times the candle-power.

Since its introduction some two years ago, the use of this lamp has been very widely extended and many colliery companies have large numbers in use.

There are many and numerous duties, apart from work at the coal face, where the greatly increased illumination given by this lamp has proved a very sound investment.

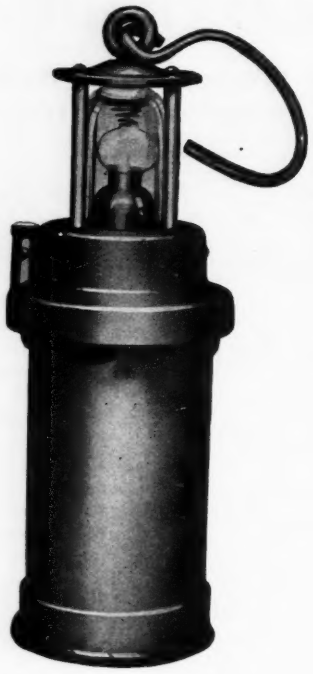


Fig. 1.—Standard "Ceag" Lamp.

Fig. 2.—"Ceag" 2-volt Swivelling Lamp.

The Swivelling Lamp.—An experimental lamp in which an endeavour has been made to usefully employ more of the total light given by the bulb, (see Fig. 2).

The bulb is carried in a swivelling head, and by the use of a scientifically designed reflector and lens, a very large percentage of the total light is concentrated into a wide angle beam which can be directed on to the work.

The swivelling type of head is fitted to both the 4-volt and 2-volt lamps, universal ball joint enabling the light to be directed in any direction without the use of connecting wires.

This ball is divided and insulated and contact made through the centre to the bulb, so giving a universal movement.

The swivelling type of head is fitted to both the 4-volt and 2-volt lamps, and is now undergoing rigorous tests.

Gas Detecting Lamp.—Of the many various and often very ingenious devices for the detection of gas with an electric safety lamp, the lamp shown above is probably one of the most practical solutions (Fig. 3).

It is free from extraneous complicated devices and has the merit of simplicity in the gas-detecting device.

This consists of a small oil chamber carried above the bulb in the "Ceag" miner's safety lamp. This oil flame is lit by a platinum wire carried above the wick by the supporting columns. These supporting columns perform the double purpose of carrying the chamber and of conducting the current from the accumulator to the platinum wire. The insulating plate in the lamp is divided so that in one position the standard bulb is illuminated, giving light for general use. A turn switches off the light and a further movement causes the current to flow through the platinum wire, heating it and so lighting the oil lamp.

The gas detecting flame is one with which the tester is already familiar. It is protected by double gauzes above and below the flame. Close regulation of the flame can be made by means of an adjustable wick tube and from 1½ per cent. to 5 per cent. of gas detected.

This Lamp, which is a patent of the "Ceag" Co., has undergone very stringent tests underground for the past 18 months, and the embodiment of the various improvements is now in hand, and it is hoped the lamp will be shortly put on the market in its final and tested form.

Quick Action Lid.—To enable the electrodes to be readily removed from the accumulator case, this quick action lid has been designed by the "Ceag" Co.

Fig. 3.—"Ceag" Gas Detector.

* March, 1925, p. 84.

By means of a simple twist of the lid, the electrodes can be removed without the use of any tool or machine.

Three peculiarly shaped lugs rise out of corresponding recesses in the case when the lid is twisted, so freeing the electrodes. When the lid is pressed on these lugs drop into position definitely locating and securing the lid and case together.

The fact that the accumulator case can be operated so easily is of great assistance to the lamp man, and encourages regular inspection and attention to the accumulator.

Improvements in Oldham Type Electric Safety Lamps.

Mr. S. J. Wrigglesworth exhibited one of the latest forms of miners' lamps manufactured by Messrs. Oldham & Sons Ltd. (Denton, Manchester).

As one of the chief components of Miners' Electric Safety Lamps is the accumulator, Messrs. Oldham & Son Ltd. have concentrated on this particular part of the lamp, and have devised an absolutely new form of accumulator known as the snap lid type. The cell case at the top is moulded in such a way that the lid once pressed into position is an absolute fixture, and without the aid of some appliance it would be impossible to remove same. On the other hand with the application of a small tool the removal of the lid together with the elements can be carried out in the fraction of a minute. Thus from the labour point of view much time is saved and from the material point of view sealing strips and other requisites of the old type of accumulator are done away with.

The adoption of the cell has proved very successful—it has overcome the question of spilling of acid, and has certainly proved a great help towards better illumination. A further improvement in recent times has been the new Oldham 4-volt lamp. This lamp, which weighs a little over 10 lbs. and gives approximately 4 c.p., will certainly prove exceedingly useful for road and other special utility work.

The New Hailwood Lamp.

Mr. F. A. Hailwood (Messrs. Ackroyd & Best Ltd.) exhibited at the meeting a new form of flame lamp which has several interesting features. This is referred to in his remarks in the discussion (pp. 37-42). With this lamp as much as 3 c.p. is stated to be obtained. This is one of the very latest developments. An illustration of the lamp was not available in time for inclusion in this issue; we hope, however, to illustrate the lamp and give fuller particulars later on.

Joel-Fors Miners' Lamps.

Mr. Henry F. Joel exhibited several of the "Joel-Fors" Miners' Electric Lamps. The ordinary approved type is of specially strong construction, weighs $4\frac{3}{4}$ lbs. and is stated to furnish $1\frac{1}{2}$ c.p. for 12 hours. The contacts are inside and cannot be made until the case is absolutely closed and the cells are unspillable and interchangeable. There is also another type of precisely similar construction but on a smaller scale, weighing only $2\frac{3}{4}$lbs. This is particularly suitable for tub boys or rescue station installations.

The foregoing standard types are probably familiar to our readers, but there are two other forms (Nos. 403 H and 303 C) that deserve notice. The former weighs 4 lbs. and yields 6 c.p. for 12 hours and the very substantial case is of aluminium. These "Road" or "Emergency" lamps are also useful for explosive factories, railways, paper mills, etc., being completely gas proof. This lamp is equipped with a screened bull's-eye lens giving a powerful beam. The third form is the inspector's or surveyor's lamp which somewhat resembles the type last described, but is lighter in build.

The miner's lamp can be equipped with the yellow-tinted bulb when desired, and we understand from Mr. Joel, who was amongst the earliest to introduce the use of yellow glass, that it is now generally acceptable and regarded as a distinct improvement in diminishing glare.

Exhibit of Philips Lamps.

Messrs. Philips Lamps Ltd. also exhibited at the meeting a case of typical bulbs for miners' lamps, as used by various leading manufacturers of miners' lamps in this country and abroad. The exhibit was of interest, both in showing the different forms of bulbs in use and as exemplifying the importance of good finish and accuracy of construction. It will be observed that in the discussion great importance was attached to the use of bulbs of good quality and operating at an efficiency sufficient to maintain at least one c.p.

Auto-Suggestion in Salesmanship

An address on the above subject, recently delivered by Mr. Llewellyn B. Atkinson at the fourth E.D.A. Conference, led to an interesting discussion. The idea of "auto-suggestion," as illustrated by the persuasive powers of the salesman, had doubtless applications. But most speakers agreed that it was only effective when allied to other valuable qualities. It is essential that the salesman should himself believe in the things he is advocating. But, as Mr. L. Gaster pointed out, what is really needed is chiefly the power of putting oneself in the place of the person addressed, coupled with a thorough knowledge of the goods or processes recommended. This undoubtedly applies very strongly to "selling illumination," and salesmanship of lamps and lighting appliances. Other speakers pointed out that a salesman might be a genius so far as persuasive powers were concerned, but unless he could be relied upon to attend strictly to his business, and unless he had a strong sense of duty, he would be a failure nevertheless. In short, the main element in successful salesmanship is still the power of inspiring confidence, which in turn depends on knowledge, both of humanity and of the goods offered.

The Ideal Home Exhibition

We note that the Ideal Home Exhibition is to be held at Olympia, London, from March 2nd to 27th, and it is stated that in some respects it will be quite different from its predecessors. One new attraction will be the "Theatre of Furnishing," in which all the leading styles will be exhibited. There will also be exhibits designed to show side by side the latest advances in domestic appliances and kitchens of several nations in the style of a century ago. It is stated that the arrangements will include object lessons in "the science of lighting, heating and ventilating the home." We hope that proper methods of lighting will receive proper attention. Certainly the historical kitchen exhibit, alluded to above, will afford an excellent opportunity of showing how much illumination has advanced during the past century.

Basle Fair

The tenth Swiss Industries Fair, originally announced to open at Basle on April 7th, will now be held from April 17th to 27th. The Basle Fair, as it is commonly called, dates back to the 15th century, and is the only exhibition of its kind to be held in Switzerland.

Representative of the entire range of Swiss manufactures, the Basle Fair is becoming increasingly popular among British business firms because of the facilities it offers for coming into direct contact with Swiss importers of raw materials.

FIG. 1.—Centrally hung Keith High-pressure Gas Lamps, as used for the lighting of Fleet Street and a portion of Cannon Street, London. The centrally hung lamps were substituted for the lamps on columns in view of the obstruction caused by the columns in these narrow, congested thoroughfares. The columns to be seen in the photograph were removed shortly after the centrally hung lamps were put into lighting.

Raising and Lowering Gear for High-pressure Gas Lamps

CENTRALLY-HUNG lamps, or lamps on brackets fixed to the buildings on each side of the thoroughfare, are frequently required for the lighting of important narrow streets along which there is heavy vehicular traffic. The use of the ordinary lamp column fixed fairly near to the edge of the curbstone is not desirable in such cases on account of the obstruction caused.

This type of street is generally illuminated by lighting units of high candle-power, such as high-pressure gas lamps. As the maintenance of these lamps must be carried out without causing delays in traffic movement, the use of ladders or tower ladders is out of the question, and gear for lowering the lamps to positions, a few feet above the pavement, in which they can be attended to from time to time, has had to be designed and constructed.

Figs. 2 and 3 show the details of lowering and traversing gear used for lamps suspended centrally over the roadway.

The arrangement indicated dispenses with the use of flexible tubing to convey the gas to the lamp, and enables a sound gas joint to be made, while still allowing the lamp to swing on a ball joint.

Fig. 2 shows details of the lamp and traversing gear. A metallic pipe (A) of suitable dimensions is carried by the suspended cable (B) to the point from which the lamp normally hangs. To the end of this pipe is connected, by a ball coupling, a " hanger " (C), which is also suspended from the cable. The lamp is suspended from the carriage (D), which is traversed inwards and outwards by means of a double winch. A special form of cup-and-ball joint has been designed to effect a proper connection between the lamp and the hanger. The " ball " half (E) is fixed to the hanger, and the inverted " cup " (F)

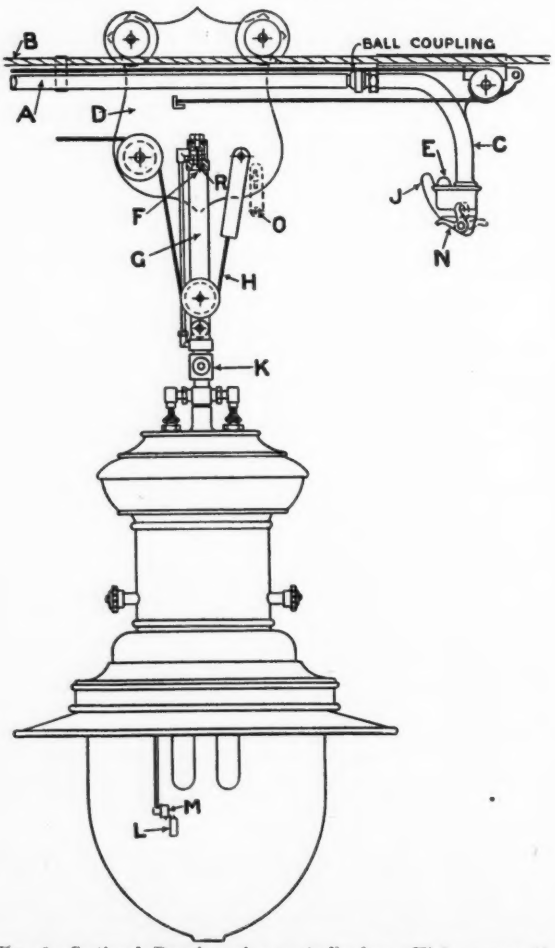


FIG. 2.—Sectional Drawing of a centrally hung High-pressure Gas Lamp, showing details of traversing gear.

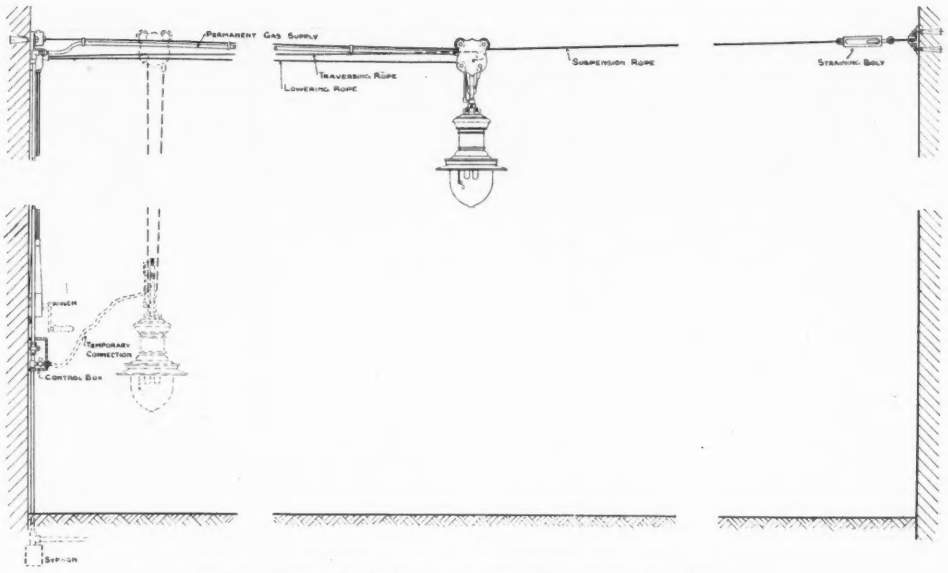


Fig. 3.—Diagrammatic section showing High-pressure Gas Lamp in position, and lowered for cleaning.

is fixed to a form of stirrup piece (G) attached to the top of the lamp. The joint is so arranged that it takes the weight of the lamp when the lamp is drawn into position. This ensures a tight joint, and at the same time relieves the running wire rope (H) of the weight of the lamp. To unship the lamp, the winding drum (to be seen on the left of Fig. 3) is turned so as to raise the cup of the lamp from the ball and clear of the safety guide (J). The carriage, with the lamp, can then be traversed inwards to the pavement, and lowered. If, when the lamp is in the lowered position, a supply of gas is required for the purpose of regulating the lamp, this is obtained by means of a flexible tube, one end of which is attached by a simple form of coupling to the cup (F) on the lamp, and the other end to a supply point in the box enclosing the control cock of the lamp.

Between the stirrup piece (G) and the lamp is fixed a special automatic lighter (K), which controls the by-pass arrangements in such a way that while the pressure is low in the supply pipe the gas is cut off from the burner and diverted to the pilot light in the lamp. When the full pressure required for lighting purposes is admitted to the service pipe, the main valve to the burner is opened automatically and the pilot light, after giving a temporary flash during the rising of the pressure, is eventually cut down to such a size as will just ensure that the bypass tube remains charged with gas. When the lamp is disconnected from the supply pipe, the bypass is, of course, extinguished, but provision is made for relighting this bypass in the attachment to the bypass protector (M) of a small tube (L) fitted with an asbestos wick. Before raising the lamp this tube is charged with methylated spirits or paraffin and lighted, so that when the lamp is drawn into its normal position, the pilot supply is relighted from it.

Arrangements are made to ensure the automatic discharge, whenever the lamp is traversed, of any condensation which may take place in the supply pipe. To prevent an escape of gas while the lamp is unshipped, a spherical valve is fixed in the ball (E), and this is held open by a pin (R) when the lamp is in position, but is closed by a spring when the lamp is removed.

One of the best examples of lighting by high-pressure gas lamps suspended in the manner described is to be seen along a portion of Cannon Street and in Fleet Street—two of the busiest thoroughfares in the City of London. (See Fig. 1.) These installations have been in use for many years, and the working of the raising, lowering and traversing gear has given every satisfaction.

Fig. 4 gives details of the raising and lowering gear for high-pressure gas lamps suspended from brackets fixed on to the walls of buildings. The gas joint is similar to that used in the case of the centrally-hung lamps described above, and the lamp is raised and lowered by a single winch. In this case provision has to be made to enable the lamp to be raised and lowered without the use of the traversing arrangement, and this

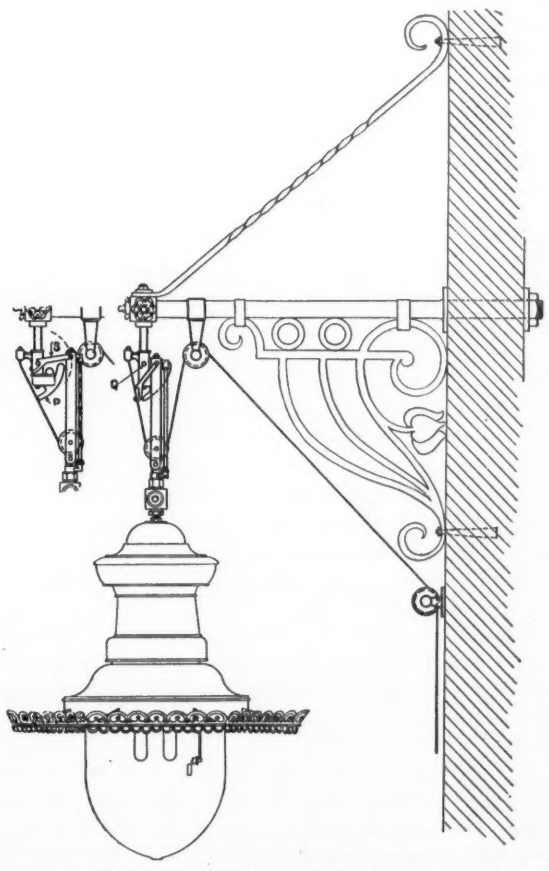


Fig. 4.—High-pressure Gas Lamp on wall bracket, fitted with Raising and Lowering Gear.

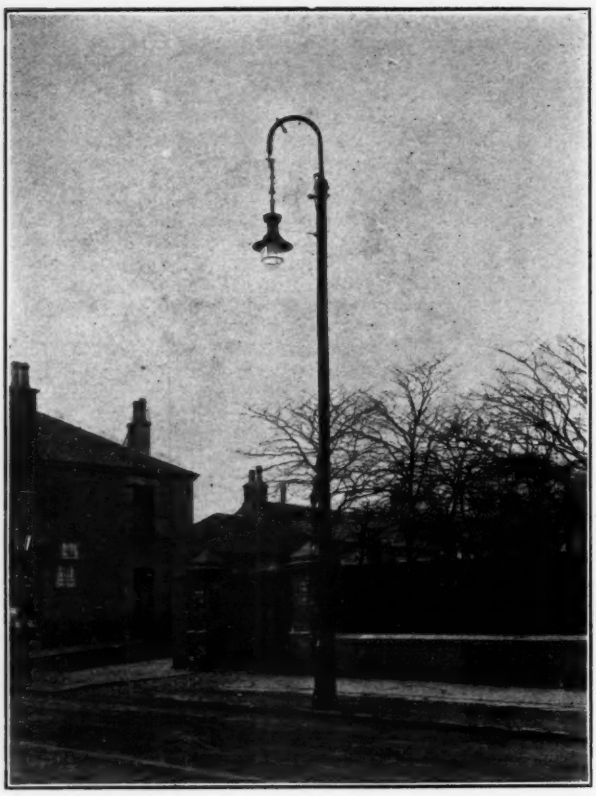


FIG. 5.—High-pressure Gas Lamp on tall swan-neck column, fitted with Raising and Lowering Gear.

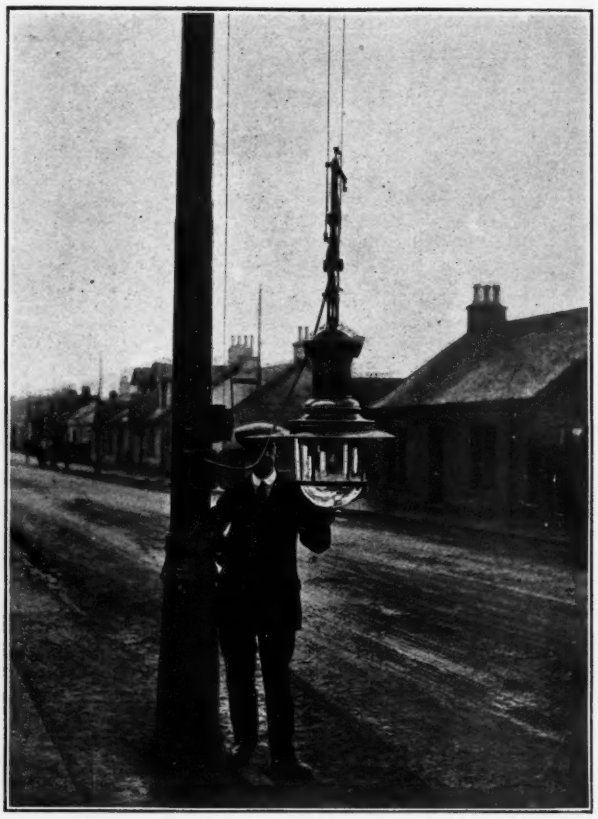


FIG. 6.—View of Gas Lamp lowered to eye-level for maintenance purposes, showing the manner in which the gas supply is connected up to the lamp, if it is required to regulate the burner when the lamp is lowered.

entails the addition of a pair of levers (S) to the stirrup piece. When the lamp is raised, the cup on the stirrup piece comes in contact with an inclined prong (P) on the lower part of the hanger, which pushes it out of the centre as it is raised. On being raised above the prong, the cup swings inwards to the centre exactly over the ball, so that when lowered it drops on to the ball, and the weight of the lamp pulling the cup down on to the ball ensures a gas-tight joint. When the lamp has to be lowered it is first raised until the ends of the two levers engage with a pair of pins (Q). These pins are fixed on the hanger in such a way that, when the lamp is again lowered, these levers cause the upper portion of the stirrup, with the cup, to describe a radial path which clears the prong. Where conditions require it, the ball half of the joint can be fitted with an automatic ball valve which closes by a spring as soon as the joint is broken, so that the lamp may be removed even if the high-pressure gas is present up to the joint The bypass is relighted in the same way as is the by-pass in the case of the centrally-hung lamp.

This system of fixing lamps is to be recommended for use in narrow thoroughfares in which there is much congestion of traffic. Many installations of this kind are in use throughout the country. For the lighting of high buildings, this device for lowering the lamp to eye-level offers distinct advantages, as it facilitates the maintenance and cleaning of the lamp, and obviates all risks attendant on the use of ladders. This risk also arises in cases where very high lamp columns such as those shown in Figs. 5 and 6 are used, and it will be seen that these columns have therefore been equipped with raising and lowering gear somewhat on the lines of that described in the foregoing notes Fig. 6 shows the manner in which the gas supply is connected up if it is required to regulate the burner when the lamp is lowered.

Gas Light and Coke Company

New Showrooms at Golders Green

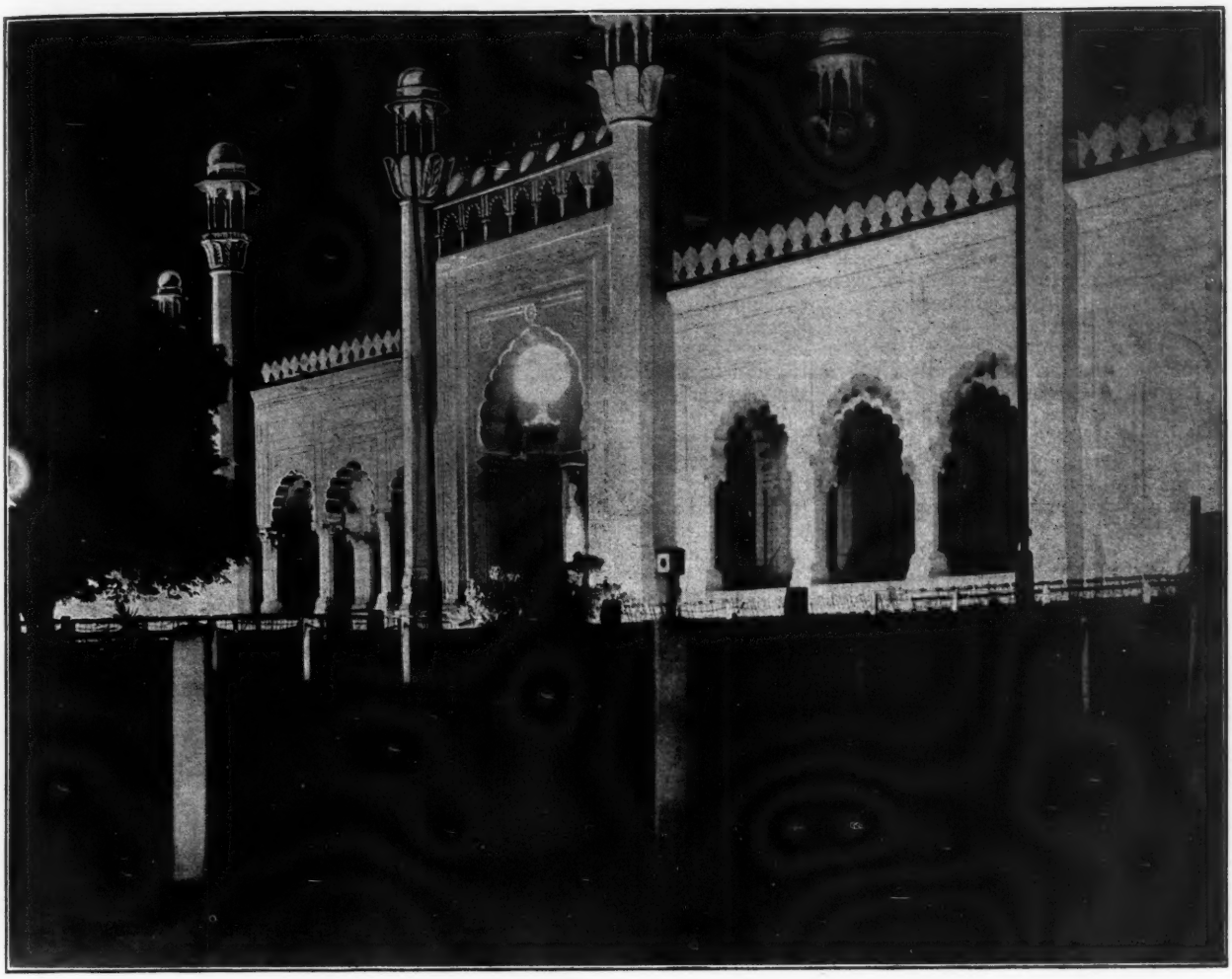
On Thursday, January 28th, the formal opening of the new showrooms of the Gas Light & Coke Company, at 110-114, Golders Green Road, took place. The opening ceremony was performed by Councillor C. C. Cartwright, Chairman of the Hendon District Council. The showrooms possess extensive window space, through which the interior is readily visible, and the colour scheme in grey and cream has a pleasing effect. The main lighting is carried out by semi-indirect fittings, controlled by switches, and the whole equipment illustrates the very latest developments in gas lamps and lighting appliances.

Personal

Mr. F. W. GOODENOUGH, C.B.E.

The announcement that the honour of "C.B.E." has been conferred upon Mr. F. W. Goodenough took place too late for notice in our last issue. We therefore gladly take this opportunity of congratulating Mr. Goodenough on this well-deserved honour, conferred by the King as a recognition of valuable services rendered in connection with the Gas Section of the British Empire Exhibition.

The efforts made by Mr. Goodenough to render the exhibit a success can be paralleled by services to the gas industry in many other directions. To our readers Mr. Goodenough is also known as a leading member of the Council of the Illuminating Engineering Society who has taken an active and sympathetic interest in its work from the earliest stages, and has given every encouragement to its aim of promoting better public appreciation of the need for good illumination.



Flood-lighting of the Indian Pavilion, British Empire Exhibition, Wembley.

Another Example of Flood-Lighting at Wembley

IN our last issue we reproduced some striking photographs showing the application of flood-lighting in connection with the Military Tattoo, which formed such a prominent feature at the British Empire Exhibition last year. The above illustration, for the use of which we are indebted to the courtesy of the General Electric Co. Ltd., shows the charming effect produced by the flood-lighting of the Indian Pavilion. The main installation consisted of flood-lights (F.B. 2505) equipped with 1,000-watt standard Osram gasfilled lamps; the minarets were illuminated by projectors (I.E. 2/854) equipped with 500-watt similar gasfilled lamps.

The white surface of this building, and its position in the grounds, together rendered it an excellent subject for flood-lighting. Its appearance by night was commented upon in an article describing the lighting arrangements at the Exhibition, which appeared in our issue of June, 1925. The contrast of the green light thrown on the walls with the rose-coloured light seen through the arches was most effective, and the appearance of the minarets seen from the lake was quite spectacular.

This installation showed what is now widely recognized—the possibilities of coloured effects in flood-lighting. The use of white light is apt to produce a somewhat ghostly and unnatural impression But when a combination of harmonious colours is used, as in this case, the appearance of the building may be made much more striking and interesting.

The New Lighting of Baker Street

AS a result of the installation recently made by the St. Marylebone Borough Council, Baker Street has fallen into line with the lighting of other famous thoroughfares, and lacks nothing on the score of adequate illumination.

The Wembley lantern, manufactured by the General Electric Co. Ltd., has been adopted, and this fitting is used throughout (including Orchard Street, which runs into Baker Street from the Oxford Street end). Illumination is provided by 750-watt Osram gasfilled lamps.

This fitting has been taken up by many of the leading Corporations. Other parts of London in which it may be seen are the Strand, St. Martin's Lane, and Whitehall, and, in the provinces, Cardiff, Nottingham, Dover, Eastbourne, and other centres.

The body of the Wembley lantern is constructed of heavy-gauge sheet copper, enamelled green on the outside, and surmounted by a copper cover ventilator of ample proportions for effective cooling. A special protected focussing device enables the lamp to be adjusted inside the prismatic refractor, and varied to give any required light distribution; adjustments can be made from the outside to an extreme of accuracy.

This lantern has been subjected to many stringent tests, and it is claimed to comply fully with the indispensable requirements in a street-lighting unit; imperviousness to all weathers, proper ventilation, accurate direction of light rays, and production of uniform illumination.

The Sheffield Illumination Society

SOCIAL EVENING.

About 120 members and friends gathered together to celebrate the first Social evening arranged under the auspices of the Sheffield Illumination Society, held at Stephenson's Restaurant, Castle Street, Sheffield, on February 9th, when Councillor W. Melling (Chairman of the Lighting Committee) presided. Councillors M. Humberstone, J. P. and S. Warren were also present.

Councillor Melling made reference to the greatly improved street lighting of the city since the appointment of a public lighting engineer and said that Sheffield had been further honoured by Mr. Colquhoun (Public Lighting Engineer) being asked to deliver a paper at the forthcoming conference of the Institution of Public Lighting Engineers, to be held at Newcastle in September next. Councillor Melling also hoped that there would be many more social evenings in connection with the Illumination Society, as they were an important factor in the development of any department. Councillor Humberstone also referred to the good work Mr. Colquhoun had done in Sheffield and wished the Society every success both in its social and technical enterprises.

The evening consisted of whist, followed by musical items, and at about 9-30 p.m. supper was served. After supper the musical programme was continued. The following artistes helped considerably in making the Social such a marked success: Miss L. Hanson, Messrs. H. Heatley, H. Green, H. Crowther and S. Hatton and Master H. Marrison, with Miss W. Hanson, accompanist. A vote of thanks to the artistes was proposed by Councillor Warren and seconded by Mr. J. F. Colquhoun.

"HOW ELECTRICITY IS SUPPLIED TO THE TRAMCARS."

The second lecture of the session was delivered by Mr. W. T. Wardale, of the Sheffield Electric Supply Department, on the 18th inst., in the Council-room at the Montgomery Hall, Sheffield, the subject being "How Electricity is Supplied to the Tramcars."

Mr. Wardale gave a description of the kind of current required for the tramways, how this is obtained, and how the current is delivered to the overhead line.

The lecturer further explained why the overhead line is divided into half-mile sections, and the cutting off automatically of the current when a fault, or extremely heavy overload, occurs.

Mr. Wardale then went on to describe the connection from the "line" to the motors, the method of control of the motors and brakes, and how the current was taken back to the Power Station.

Records of pressure and output were handed round to the members for inspection, and also a sample of cable.

The lecture was illustrated by lantern slides, and Mr. Wardale gave many diagrams on the blackboard.

Mr. J. F. Colquhoun (Public Lighting Engineer) proposed a very hearty vote of thanks to Mr. Wardale and said the lecture had been most interesting and instructive.

A Commercial Lighting Campaign

Another instance of successful co-operation between electric supply undertakings and fittings manufacturers is reported in *The Electrical World* by Mr. G. B. Foster, of the Washington Water Power Co. In the late weeks of 1925 a commercial lighting campaign was initiated. Of 660 units placed on trial, all but 71 were taken by customers. It has been found that at least 85 kilowatts was thus added to the load, and this should produce a revenue of 3,200 dollars per annum. The revenue of about 40 dollars per kilowatt thus obtained compares quite favourably with results from electric ranges. It is reckoned that the average cost of the campaign to the Company was only about 43 cents (less than 2s.) for each unit installed. In addition, the educational value of the campaign, which will no doubt result in further additions to the lighting load in the future, deserves consideration.

Flood-Lighting at a New West End Cinema

The accompanying illustration, reproduced from *Holophane Illumination*, shows the new Holophane Flood-lighting which has recently been installed at the new Kensington Cinema by Messrs. Blackburn, Starling & Co., the well-known theatre engineers.

This frontage is 50 feet wide and has a height of 34 feet. Ten Holophane F1,500 Flood-light units, in conjunction with 500-watt lamps, are used, and the picture gives a good idea of the effective result. The scheme was carried out to Holophane specification under the direction of Mr. F. Wingfield Bowles, the Consulting Engineer.

It is somewhat curious that as yet flood-lighting has not been very widely applied to the frontages of cinemas. Cinemas appear to offer a specially good field for this system of lighting; it has evident advantages as an attraction, and many cinema buildings, being new, have light-coloured surfaces which are conveniently flood-lighted.

Afternoon Show-Window Lighting

An enterprising departure was recently made by the Utah Power and Light Company (Salt Lake City, U.S.A.). During December a letter was addressed to leading merchants pointing out that the greatest number of shoppers are in streets during the afternoon hours, and as in December cloudy days and relatively poor natural lighting are usual, the effectiveness of windows is increased if artificial lighting is turned on early in the afternoon instead of at dusk. A special schedule was offered under which lights could be turned on from 1 p.m. onwards. At the same time the services of the Company, in arranging specially attractive lighting displays were offered. It is stated that approximately 25 per cent. of the customers approached adopted this service during December, and general satisfaction with the results of the earlier lighting was expressed. The Company derived an additional income of nearly 10 dollars per customer for the month from this form of business. This seems an idea worth consideration in this country, where during the mid-winter months the amount of daylight available is not very great, especially in city streets with tall buildings.

Theatre and Cinema Colour-Lighting

THE last issue of *Holophane Illumination* is devoted mainly to theatre and cinema colour-lighting, though some reference is also made to such matters as the use of colour in the home and for shop-window and spectacular lighting. The use of subdued lighting, embodying pleasing colour harmonies, is of great value in the cinema in the intervals of showing films, and the Holophane Prismatic Colour-Units seem to have been especially acceptable for this kind of work. A very interesting contribution by Major Adrian Klein on "The Future of Coloured Lighting" is included. Major Klein reviews early pioneering work in this field, including various attempts to devise "colour-music" or to combine coloured light-effects with instrumental performances. Rimington's "colour-organ" is a case in point. The idea of "colour-music," i.e., displays of changing coloured light intended to be analogous to a musical performance needs some understanding, and the parallel between the chromatic and musical scale is perhaps not as close as is sometimes assumed. It remains to be seen whether the display of "colour-music" will develop into a finished art. But there can be no doubt about the great potentialities of colour as a supplement to cinema and theatrical displays. The issue also contains good illustrations of a considerable number of cinemas in which Holophane Colour-Units have been installed, and examples of effect in exterior lighting. There is also a reference to the Holophane Colour-Projector, which appears well adapted to display during musical interludes, etc., and the Holophane Cinema Screen, which is stated to give very fine results.

The two accompanying illustrations afford different examples of Holophane installation. Fig. 1 shows the De Montfort Concert Hall at Leicester, which is illuminated by Holophane Refractor units, giving a well-diffused illumination of 3-4 foot-candles. There are also auxiliary bracket lights intended for use when a ball is in progress.

FIG. 1.—The Lighting of the De Montfort Hall, Leicester.

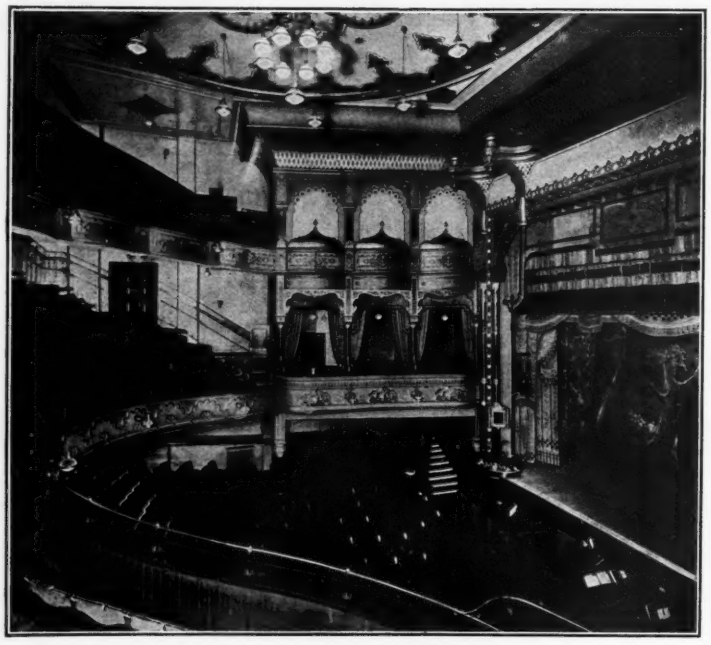


FIG. 2.—The Lighting of the Camberwell Palace of Varieties, London.

The second illustration, of the Camberwell Palace of Varieties, shows both white and colour lighting, independently controlled and designed to be in complete harmony with the general scheme of decoration.

Other illustrations in *Holophane Illumination*, for instance those of the Vaudeville Cinema, Reading, and the Electric Palace at Oxford, show the method of lighting now favoured of mounting bowls or luminous panels direct on the ceiling. This method lends itself particularly well to colour-treatment. A special instance of effective flood-lighting is seen in the treatment of a cinema tower at Ilford. Reference is also made to the use of flood-lighting in other fields, the lighting of the Dome during the I.M.E.A. Convention at Brighton being mentioned as an instance of skilful treatment. Here, again, the use of colour has great possibilities, as the effect of white light is apt to be somewhat flat and unnatural.

On the stage, batteries of coloured lights, spot-lights provided with transparencies of delicate hues, etc., form an essential part of the equipment. By their aid daylight may be imitated, and the gradual change from sunrise to sunset, and from sunset to moonlight and dawn reproduced. Marvellous effects have likewise been obtained by the combination of coloured light and the hues of the dresses of dancers, etc. It is now many years since Lois Fuller created a sensation by dances in which changing coloured light falling on her costume played an important part.

Quite recently the idea of projecting coloured scenery from a gigantic lantern, as a substitute for painted canvas, has been experimented with. The lighting of the auditorium of a theatre offers great possibilities in the application of coloured light.

There are, in short, few fields of lighting in which colour does not play an important part, and its value is likely to be even more appreciated in the future.

TRADE NOTES & ANNOUNCEMENTS

WARDLE SHOP-LIGHTING UNITS.

We have received from the Wardle Engineering Co. Ltd. (Manchester) a booklet containing particulars of some modern and useful fittings for shop and window lighting. The window-lighting units, one of which is illustrated, constitute a somewhat novel departure, being of the porcelain-enamelled type. These reflectors, besides being durable, are very easily cleaned. Two distinct types, intensive or extensive according to the dimensions and shape of the window, are available, and the contours of the reflectors enable widely different curves of light distribution to be obtained. For best results the units should be spaced at intervals of 18 in. to 30 in. according to the nature of the display and the illumination required. Like other window-lighting reflectors, these porcelain-enamelled types can be fitted with colour-screens if desired.

Wardle Window Units, available both in the Intensive pattern (for high shallow windows) and the Extensive type (for average or deep windows).

Wardelyte Totally-enclosed Ceiling Fitting.

The other unit illustrated is suitable for interior lighting, being of the enclosed dustproof type, and pleasing in appearance. The form shown is designed for mounting direct on the ceiling, but these units can be equally well suspended on chains. The glass, whilst sufficiently diffusing to present an evenly illuminated surface, has been specially selected with a view to minimum absorption of light.

Flood-lighting of the Union Buildings, Pretoria.

G.E.C. FLOOD-LIGHTING.

An attractive catalogue issued by the General Electric Co. Ltd. shows the wide variety of uses to which flood-lighting is now being put. Illustrations of its effect at Wembley are included, and there are also some striking examples of the lighting of exteriors of cinemas, advertisement placards, war memorials, etc.

The picture above shows the flood-lighting of the Union Buildings, Pretoria, for which I.E. 2/93 flood-lights, equipped with 500-watt Osram gasfilled lamps, were used. This is not the first illustration we have published showing the use of flood-lighting in South Africa, and it appears that the system is being readily taken up in that country.

SIEMENS EXHIBIT AT THE BRITISH INDUSTRIES FAIR.

At this year's British Industries Fair, at Castle Bromwich, Messrs. Siemens and English Electric Ltd. are arranging for their stand to be lighted with Siemens gasfilled lamps and "Silvaray" fittings. At the stall all the chief types of electric lamps will be shown. There will also be a representative display of heating and cooking appliances, including Siemens "Xcel" cooking ranges, irons, fires, table cookers, boiling plates, kettles, etc., and "Zed" fuse material.

CAPE TO CAIRO BY MAZDA LIGHT.

Readers will have followed with interest the accounts in the press of the Court-Treatt motor expedition from the Cape of Good Hope to Cairo. This expedition fought its way for 16 months through almost impenetrable country, and covered a distance of 12,732 miles. The experience is naturally of great interest to motorists. To our readers it may be of interest to note that Mazda Electric Lamp Bulbs were used successfully throughout the journey—another instance of the penetration of modern illuminants into almost unexplored country.

COLOURED LIGHTING OF DISPLAY WINDOWS.

A booklet issued by the British Thomson-Houston Co. Ltd. is devoted to colour lighting effects in shop windows. Details are given of the chief types of X-ray Reflectors, and there are two illustrations of attractive window displays, reproduced without retouching of any kind, from Lumière natural-colour photographs, taken by the unaided light of the B.T.-H. Window Lighting Units.

Personal

Mr. E. F. Darker, the London representative of Benjamin Electric Ltd., who is shortly leaving for South Africa, desires to be remembered to all his friends met in London and at the Wembley Exhibition. We wish Mr. Darker a prosperous and pleasant journey.

SEECOL'S FILM STUDIO.

When Lord Darling made his screen debut in Widgey R. Newman's latest picture ("Secrets of Handwriting"), the filming was carried out with the co-operation of the Strand Electric and Engineering Co. Ltd. A position in the showrooms at Floral Street was selected, and experiments showed that the "Sunray" and "Arena" lighting units, though not very rich in actinic value, gave a soft effect which answered the purpose very well. A letter since received from Mr. Newman expresses great satisfaction with the effect of the "Sunray" lanterns, especially in saving sitters from the fatiguing effect of exposure to very bright unscreened sources.

A "CORRECT LIGHTING CHART."

A very useful form of chart has been issued by the Benjamin Electric Ltd. Whilst illustrating the chief forms of Benjamin reflectors, the chart also presents some sound hints on lighting. Copies are obtainable on application to the Company, and traders who exhibit them on their walls will be doing good service in broadcasting the main principles of good illumination.

HOSPITAL FITTINGS.

The "Omnipoise" hospital fitting illustrated in a recent list issued by the General Electric Co. Ltd. is specially intended for hospitals, surgeries, nursing homes, etc. It is mounted on a fixed bracket, but is evidently very adjustable, only a slight touch being necessary to project the light in any desired direction.

CONTRACTS CLOSED.

The following contracts are announced :—

BRITISH THOMSON-HOUSTON CO. LTD. :
Southern Railway; six months' contract for the supply of Mazda vacuum and gasfilled lamps.

METRO-VICK SUPPLIES LTD. :
Admiralty, Director of Naval Contracts; part contract for "Cosmos" shore-type and ships'-type vacuum metal-filament lamps and gasfilled lamps.

SIEMENS AND ENGLISH ELECTRIC LAMP CO. LTD. :
Southern Railway; for the supply of Siemens Electric Lamps, vacuum and gasfilled, for a period of six months from 1st March.

THE "SPECTRUM COMPARATOR."

From Messrs. Adam Hilger Ltd. we receive a brief description of the Spectrum Comparator, which enables two spectra to be projected side by side on to a white screen, and compared. The whole apparatus is very compact, and is mounted on a rigid stand, so that it can be moved with ease about the dark room or laboratory.

SILK SHADES.

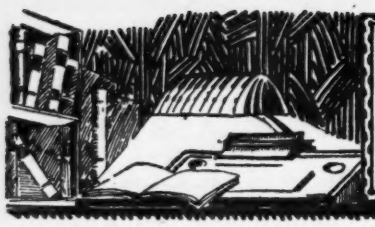
Attention was drawn last year to the ingenious "illuminated creatures" constructed by Mr. Charles Selz for use in the grounds of the British Empire Exhibition. A feature of these devices was the use of special impregnated and waterproof material. Mr. Selz is, however, also a specialist in silk shades for ordinary domestic use, and a leaflet before us portrays the use of those in the drawing-room, dining-room, bedroom, etc. More elaborate designs for use in cinemas, dance halls, etc., are also illustrated.

GAS LIGHTING IN THE COVERED-IN MARKET.

A recent issue of "A Thousand-and-One Uses of Gas" contains some effective illustrations of the lighting of covered-in markets, including those of the Wakefield Corporation, the Fulham Market, and some avenues in Euston Square. Throughout the country there must be a considerable number of these markets, many of them very busily occupied. In many cases the artificial lighting is far from ideal, and there is need for modern methods. In the gas lighting of areas of this character distant control of the gas lamps plays an important part.

G.E.C. CATALOGUE.

The General Electric Co. Ltd. has issued a comprehensive and copiously illustrated catalogue, "G.E.C. Illuminated Signs, Flashers and Accessories," covering every conceivable requirement in the illuminated sign. Letter signs, illuminated box signs and brackets, window signs, G.E.C. "Internalite" electric signs, etc., are illustrated with working examples, and fully described. Thermic flashers, motor-driven flashers and automatic time switches are also included, with, of course, Osram sign-type lamp, and colour caps and hoods for use with them. This is a useful and informative publication in the hands of the trade.



REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED

THE BULLETIN OF HYGIENE, *Vol.* 1, *No.* 1, 1926; *Bureau of Hygiene and Tropical Diseases, London; 2s. 6d. net, 21s. per annum.*

The first issue of the Bulletin of Hygiene, issued by the Bureau of Hygiene and Tropical Diseases, is an interesting production, consisting mainly of summaries of contributions in various medical journals. The first section deals with maternity and child welfare. The next section, on industrial hygiene, deals particularly with lead poisoning, industrial dermatitis, etc., and the annual reports of the Chief Inspector of Factories for 1924, the Committee of the Miners' Welfare Fund, and the Industrial Fatigue Research Board are summarized. Other matters dealt with include bacteriology, milk, smallpox and vaccination, sanitary engineering, light therapy, and hygiene in the tropics. The Bulletin thus covers a wide range, and should be very useful to medical men in keeping them in touch with developments. Even to those outside the medical profession, some of the sections are of interest. Thus the contributions under "Light Therapy" give one a survey of developments in light treatment with ultra-violet rays. Several contributions deal with the importance of "dosage," and one can well understand that, in dealing with these new forms of radiation, the need for careful measurements of the amount of the stimulus should be realized.

LIGHT AND HEALTH, *by M. Luckiesh and A. J. Pacini. (Ballière Tindall and Cox, London,* 1925, *pp.* 302, *Figs.* 31.)

A book in which Mr. Luckiesh is concerned is invariably readable, and "Light and Health" is no exception. The subject is one that is now attracting great public interest, and it is most desirable that both the physical characteristics and physiological effect of the various new forms of radiation should be studied. In the first chapter the authors contribute an excellent survey of radiation from the physical side. The nature of solar radiation, and the manner in which it is absorbed by various media are first tabulated. Later, similar data are presented for artificial illuminations. We notice, for instance, a series of photographs of the spectra of arcs, mercury-vapour lamps, and similar sources rich in ultra-violet light, both when unscreened, and when various materials are interposed. The nature of X-rays and other special rays are explained. In Chapter II (Climate and the Human Race), the authors illustrate the widely different climatic conditions under which the human race lives and the effect of migration. Generally speaking, blonde races do not readily adapt themselves to tropical climates and brilliant sun; on the other hand, they do well in such places as Alaska, where sunshine is recorded only for one or two days a week and the summers are brief. The reactions of plants, animals and human beings to light are next analyzed, and this leads to a discussion of the part played by light in health and disease. There are apparently a number of bone-diseases which are due to "sunlight starvation," and whilst it is true that the human body can adapt itself, compensating in some degree for lack of sunlight, darkness and depression are linked together as intimately as light and freshness.

Subsequent chapters deal with the influence of light on the blood, skin, glands, bones and muscles. Many of these effects seem to be inter-related. The effect of the glands on the human body is still very imperfectly understood, but in some cases deficiencies in secretion may have a profound influence. Apparently exposure to ultra-violet light may have a stimulating influence, e.g., in making good deficiencies in the thyroid gland. The influence of ultra-violet radiation on the calcium content of the blood and bone structure has been much investigated; for instance, its beneficial effect in cases of rickets. Similarly it is believed that the condition of the teeth may in some measure be connected with the influence of ultra-violet light. The effect of light, and especially coloured light, on the nerves forms a very interesting but debatable subject, but charlatan exploitation of chromotherapy has done much to dampen scientific interest in this field.

A special chapter is devoted to the effect of light on infection, and the use of ultra-violet rays in treating skin diseases and destroying bacteria. Under the title "Light and Hygiene" the authors refer to the purifying action of light on air, and the curious vitalizing action of ultra-violet rays on certain liquids and foodstuffs. (A curious instance being the alleged loss in nutritive value of spaghetti dried indoors, as compared with that treated in the open air.) The authors also deal with the familiar facts about the effect of excess of ultra-violet light on the eye and the psychological effects of the various colours. The final chapter on "Lighting for Health and Happiness" deals mainly with the fundamental principles of good illumination and its value in relation to health, safety and efficiency of work.

A REPORT ON ARTIFICIAL LIGHT AND X-RAY TREATMENT, *issued by the Corporation of Glasgow, Public Health Department.*

From Mr. S. B. Langlands, the Inspector of Lighting to the Glasgow Corporation, we receive a copy of the above report, which illustrates the enterprise of the Corporation in taking up this new treatment. Work is being carried on at four chief centres, two of which are chiefly outdoor clinics. The equipment includes both arc lamps (carbon and tungsten-cored) and mercury-vapour lamps, so that useful information on their respective effects, as compared with sunlight, should be obtained. A report by Dr. Smith on experiences at the Robroyston Sanatorium describes results obtained in cases of lupus, tubercular affections, etc., in many cases successful. Some ailments are more intractable than others. In most cases the initial exposure is about twenty minutes, but the duration of the light bath has to be carefully considered in relation to the condition of the patient. It is curious to note that a patient treated with the mercury-vapour lamp can usually be distinguished from one treated by natural sunlight owing to the yellowish-green colour; sunlight and the carbon arc both give a brownish colouration, scarcely distinguishable, and the tungsten arc a colour intermediate in hue. However, the opinion is expressed that pigmentation cannot be taken as an indication of therapeutic value. There are supplementary reports by other physicians in charge of treatment. Whilst results are hopeful, it is emphasized that much time is yet necessary before the total benefit of various forms of treatment in tuberculosis cases can be properly estimated.

Electrical Freedom.—A booklet under the above title, issued by the Electrical Contractors' Association, sets out the case of the electrical contractors in connection with proposals for the development of electricity. Briefly, the contention is that public supplies of electricity should be under public control, and that such supplies of power should be under State or semi-State direction or regulation. But it is contended that public control of trading should not extend beyond provision of ample supplies of the power itself, and that wiring and installation, and retail trading should be left in private hands. At the same time, approval is expressed in the promotion of sound schemes of bringing before the public the advantages of "Electric Service." The question dealt with in the booklet is naturally a debatable one; but at the present time, when developments in electric supply are the subject of so much discussion, it is right that the views of electrical contractors, in whose hands installation work largely rests, should be taken into consideration. Their position has doubtless been greatly strengthened by the formation of the National Register of Electrical Installation Contractors, which provides a list of competent firms.

ELECTRICAL PHOTOMETRY AND ILLUMINATION, *by Herman Bohle, Professor of Electrotechnics at the University of Cape Town. (Chas. Griffin & Co. Ltd., London, 1925, pp. 427. Second edition, 25s. net.)*

A short time ago we commented upon the work by Messrs. Cady and Dates, designed to serve as a textbook on illumination for students in the United States. Professor Bohle's work is likewise founded on the course of lectures delivered by him at the University of Cape Town. The new edition, however, brings the subject up to date, and is much more complete than the original volume. It is very fully illustrated, and the author has evidently kept himself in close touch with developments in illuminating engineering, both in this country and in the United States.

Chapter I deals with Photometric Quantities, Units, and Standards; Chapter II with Radiation and light sources. The account of the latter seems quite up to date, such sources as the " Pointolite " and neon lamps being mentioned. The chapters dealing with photometry are also comprehensive. The section on illumination photometers contains descriptions of most of the leading types, British, German and American—though we notice that the diagram of the lumeter is apparently based on a very early form of this instrument. The Testing of Electric Lamps and Illumination is another lengthy chapter. The various methods of determining mean spherical candle-power from the polar curve are discussed in detail, and methods of testing electric lamps and recording data are fully treated. We notice also an account of methods of testing coefficients of diffuse reflection by means of the Ulbricht Globe.

The chapter on Globes, Shades and Reflectors contains many illustrations of modern types, and includes the treatment of searchlights, lighthouses and motor headlights. As an illustration of modern recommendations on headlights, the author quotes those of the London " Safety First " Council. Types of incandescent lamps for kinema projectors are also illustrated.

The chapter on illuminating engineering contains the familiar tables summarizing the efficiency of modern illuminants. As his basis for recommendations on the intensity of illumination for various processes the author presents data from the American Codes. The tables of efficiencies of utilization for various fittings is familiar, but the author also shows how the illumination to be expected in a given installation may be calculated from first principles. General hints on the lighting of offices, factories, schools, libraries, etc., are aided by illustrations, many of which originally appeared in *The Illuminating Engineer*, to which the author makes frequent reference. There are also one or two special illustrations on insets of art paper, including a spectacular photograph of the lighting at the Panama-Pacific Exhibition. The bibliography is exceptionally good, all references for the various chapters being tabulated at the end of the book.

Altogether, the second edition of Professor Bohle's work should prove a useful book to students. We record with pleasure this illustration of the interest being taken in South Africa in illuminating engineering, and of the attention with which developments in other countries have been studied.

A BOON TO POSTAL ADVERTISERS.

On the representation of the Incorporated Society of British Advertisers, the Post Office Authorities are considering the adoption of a new procedure in connection with the passing of an official opinion as to the admissibility of matter for delivery at printed matter rate of postage.

Hitherto such an opinion has been given only on submission of the matter in its final printed form, and it has often happened that firms have been put to considerable expense for printing, only to find that the matter was not admissible at the printed matter rate.

At the suggestion of the Society it has now been arranged for an official of the G.P.O. to receive and pass an opinion on matter submitted in dummy form, by way of experiment. If the procedure is found to work satisfactorily it may be adopted as standard practice.

INDEX (February, 1926).

EDITORIAL NOTES :—
Problems in the Lighting of Coal Mines—The City Smoke Problem and the Press—A New Tungsten Arc Lamp—Illumination and Light 33

NOTES AND NEWS ON ILLUMINATION 35

NEWS FROM ABROAD 36

TECHNICAL SECTION :—
Transactions of the Illuminating Engineering Society (Founded in London, 1909):
The Lighting of Coal Mines (Proceedings at Meeting held on January 21st, 1926 37
A Self-starting Tungsten Arc, by N. A. Halbertsma 43
The B.E.S.A. Specification for Industrial Reflector Fittings for Electric Lighting 44
Obituary—
Mr. Leonard G. Tate 45
Two-filament Headlight Lamps—Propaganda on Illuminating Engineering 46

POPULAR AND TRADE SECTION :—
Electric Lamps, Some Notes on; Traction Lamps, by W. J. Jones 47
Miners' Lamps, Exhibit of 48
High-pressure Gas Lamps, Raising and Lowering Gear 50
Flood-lighting at Wembley 53
Baker Street, New Lighting of 53
Sheffield Illumination Society 54
Flood-lighting of a Cinema 54
Theatre and Cinema Lighting 56

TRADE NOTES 58

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED 62